EAR OF
PC
HE YEAR

# PRODUCTS OF THE YEAR!

# apc

Xmas 2017
Issue 449

YOUR EXPERT GUIDE TO TODAY'S TECH

*APC*'S CRACK TEAM OF TESTERS SELECT THEIR FAVOURITE PRODUCTS OF 2017

# INTEL LEVELS UP TO TAKE ON AMD'S RYZEN

## THE CORE-COUNTS ARE UP & THE PRICES ARE DOWN, BUT CAN INTEL'S NEW CHIPS WITHSTAND A RESURGENT AMD?


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SUBSCRIPTION ENQUIRIES: Please call Magshop 13 61 16
Email: apcmag@futurenet.com
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*APC* is published by Future Publishing Australia.

Distributed in Australia and NZ by Network Services.

Printed by Bluestar
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FIPP

GEAR OF apc THE YEAR

# An unexpectedly big year for tech

## *APC*'s editor looks back at the big tech trends and issues of 2017.

To say that 2017's been a year of surprises is a bit of an understatement. From just a 'core hardware' perspective, we've seen huge changes in the CPU scene, headlined by the return of AMD to the high-end desktop chip market, with Ryzen and then Threadripper proving that the underdog can indeed still hold its own against Intel when it comes to building CPUs for a wide spectrum of needs.

And AMD's successful resurrection of its CPU business has certainly rattled Intel, who launched two mainstream desktop platforms – the 7th-gen/Z270 and 8th-gen/Z370 lines – which, historically, has finally pushed the chip giant to release its first six-core consumer processors. It's hard to overstate what an important milestone this is: with AMD not offering much competition on high-performance desktop CPUs, Intel's been happy to stick with a quad-core design for its mainstream chips for almost a decade now, since the first Core i CPUs were introduced way back in 2008.

Elsewhere, the continuing crypto-currency mining gold rush has pushed up demand for graphics cards which has, in turn, seen a spike in the price of most midrange cards, but the trend has even bled a little into the edges of the budget and premium market sectors, too. I can't remember any other year when the same GPU was actually *cheaper* in January than in December, but here we are...

Then there's the other continuing tech news story that, I'm sure, many wish would go away: the effect of fake news on our political discourse, which experts agree has been used to influence major elections and issues from Brexit in the UK to the election of Donald Trump in the US.

On a less-controversial (or perhaps more, depending on how passionate a techy you are), this is also the time of year when we here at *APC* choose our favourite products. As was the case in 2016's list, the majority of our recommendations have come from the pages of *APC* itself, but there's so much tech out there that we've leaned on some of our sister publications (both online and print) including *TechLife*, *TechRadar* (**www.techradar.com**) and *PC Gamer* (**www.pcgamer.com**) for some of the final award-winners. If you're looking to buy tech for either yourself or friends and family, we hope this feature will make selecting the right gear a little easier.

We like to think our choices are fairly definitive, but if you've picked up a great tech product in 2017 that's not on our list, we'd be keen to know about it – flick us an email to **apcmag@futurenet.com** telling us why you love it! ■

**DAN GARDINER**
EDITOR-IN-CHIEF
**dan.gardiner@futurenet.com**

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# exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

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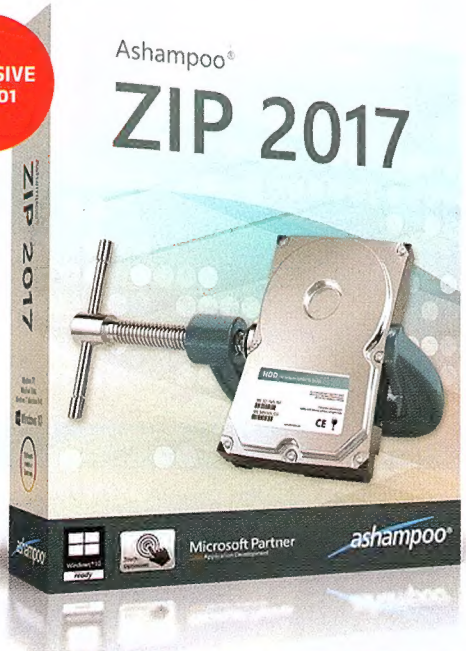
EXCLUSIVE GIFT 01

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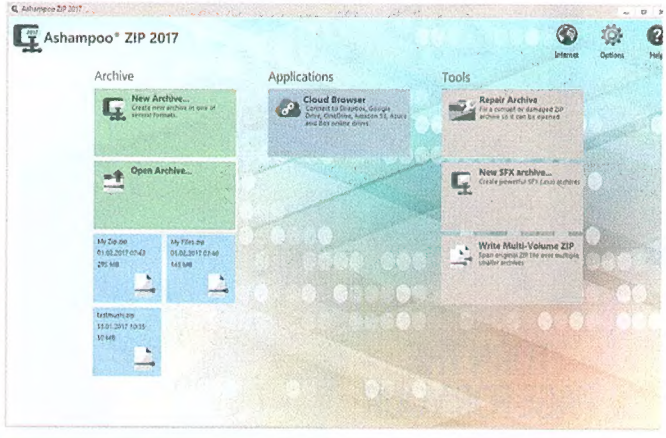


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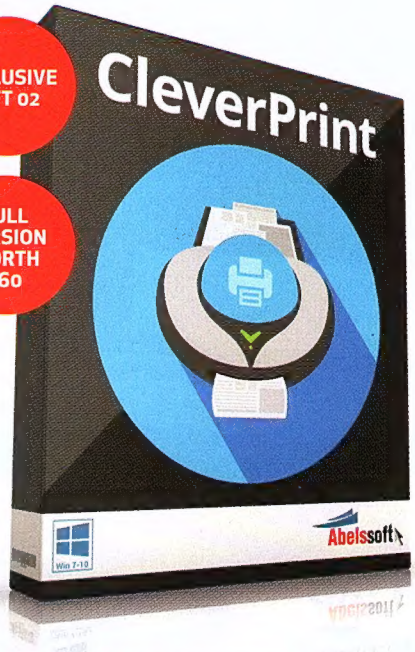


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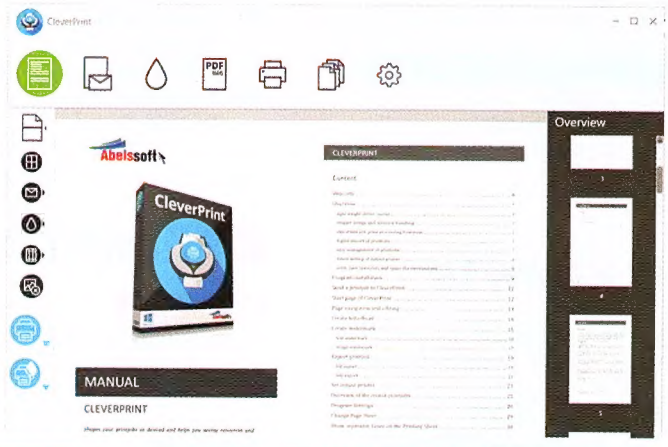


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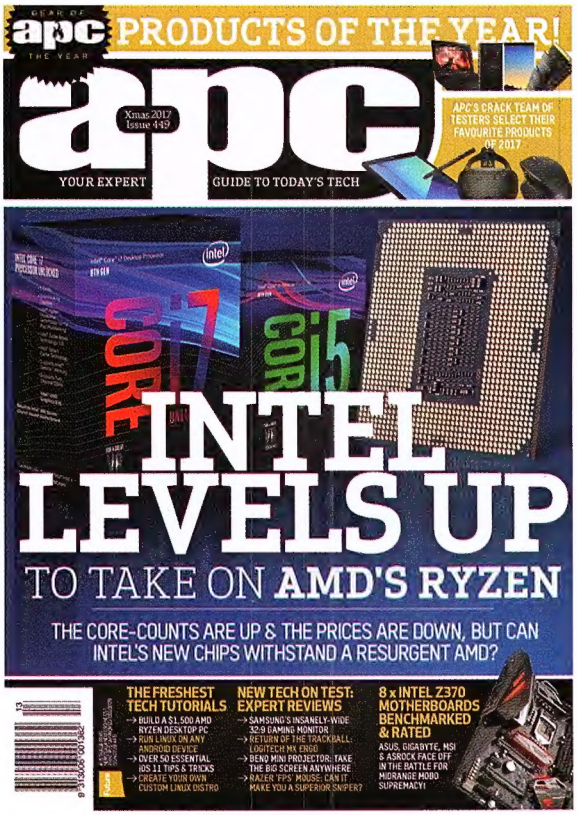
# technotes

» INSIDE APC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→ RAZER 'FPS' MOUSE: CAN IT MAKE YOU A SUPERIOR SNIPER?
8 x INTEL Z370 MOTHERBOARDS BENCHMARKED & RATED
ASUS, GIGABYTE, MSI & ASROCK FACE OFF IN THE BATTLE FOR MIDRANGE MOBO SUPREMACY!

the lab » latest reviews
apc HOT PRODUCT
GAMING MOUSE
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ASUS RoG Strix Evolve
A little southpaw spice.
The ASUS RoG Strix Evolve Aura RGB USB Wired Optical Ergonomic Ambidextrous Gaming Mouse (7,200dpi) – which sounds more like keyword targeting than product naming – is the first ambidextrous mouse we've seen that has gone beyond a simple symmetrical design and truly innovated.
Included in the box are four interchangeable top plates – a high and low profile for the left and the same for the right – which, when attached in different configurations, offer four distinct feels: left handed, right-handed or high and low neutral (or flat). Sound weird? It's actually a really clever design. This reviewer likes a little ergonomics, so clipping a high plate on the left and a low on the right results in a nice tapered feel in the right hand. But if you're a heathen who prefers symmetry, using a high profile on both sides gives a more DeathAdder-like feel. At 12.5 x 6.5 x 4.1cm, the Evolve feels long and narrow in the hand which is fine for this ape-pawed full-fister, but might be off-putting for fingertip gamers though the kung-fu grip on the sides helps maintain control. Looking deeper, the Evolve boasts durable Omron switches good for 50 million clicks and an optical sensor with 7,200dpi, 30g acceleration and 1,000hz polling.
The split chassis features a neat lighting system with the middle and tail illuminating in more colour options than anyone really needs, which, of course, can be tailored to match your keyboard, headset and PC LEDs through ASUS's downloadable software. And best of all, it's cheap!
Troy Coleman
Verdict
★★★★★
apc HOT PRODUCT
GAMING MOUSE
$100 | WWW.RAZERZONE.COM
Razer Basilisk
An FPS gaming mouse that'll have you clutching for headshots.
Judging by the name, Razer really think its new 'FPS mouse' is the shizzle. European folklore holds that the basilisk – a mythological chimera-like creature – is the 'king of the serpents', able to kill enemies with just a glance. There's just one problem with that 'kingly' identification: Razer arguably already has a top-dog gaming mouse in the form of the DeathAdder.
Razer claims that this is perfect for first-person shooters, largely thanks to a new thumb button called the 'DPI clutch'. Hold it down and it'll temporarily adjust your DPI sensitivity to whatever pre-determined setting you've configured. The theory is that you can use a higher sensitivity most of the time, but temporarily drop it down if you need fine-control over smaller movements – when you're peering through the lens of a sniper scope, for example. And, somewhat surprisingly, that little button certainly seems to make it feel easier to quickly zero-in.
The Basilisk's design is a little unconventional for a Razer mouse, using a more aerodynamic body profile than we're used to, which incorporates a tapered front and back and a slightly taller rear – making this well-suited to palm-grip gamers. Large ridged-rubber sections on each side also help keep the Basilisk firmly in your hand.
In short, while we're not quite willing to crown it as the definitive DeathAdder killer, if you play a lot of FPSes and want to pull off more headshots, this mouse may give you a slight edge – and we're looking forward to seeing that DPI clutch used in other designs.
Dan Gardiner
Verdict
★★★★★
30 www.apcmag.com
Razer Tiamat 2.2 V2
Logitech Brio 4K Stream Edition
Cooler Master Masterset MS121
Logitech MX Ergo

# Inside APC

## Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results and more.

*APC* is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

### INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

### LABS TESTING

Despite being a small magazine with limited resources, *APC* still still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule and where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

# technotes

» NEED TO KNOW

## Kodi users tricked into installing anti-piracy spyware

THE HUNTER BECOMES THE HUNTED...

Users of third-party Kodi skins have discovered that these optional extras have been partnered with monitoring software that checks whether the user's other add-ons are legitimate, effectively making them a form of spyware. Recently, this software has been bundled with the skins Estuary MOD V2 and Embuary, and the monitoring is being enabled by an add-on called KN Addon Caretaker, so look out for this if you're a Kodi user. **HD**

## NBN Co now blaming birds for network woes

POLLY WANNA HACK APART A BROADBAND LINE?

NBN Co has run into the unique problem of having its infrastructure damaged by pesky Australian cockatoos, particularly in regional districts of our nation. The company has already spent $80,000 repairing the cable damage wrought by these mischief-makers, which chew the tasty morsels in an attempt to keep their ever-growing beaks in check. Thankfully, the company has devised a $14 solution, encasing the exposed cabling in a small plastic canister — and potentially saving upwards of $10,000 per damaged cable. **HD**

## Enterprise hard drives are no more reliable than consumer models, report says

SO WHY THE PRICE HIKE?

According to a report by cloud-backup provider Blackblaze, the hard drives that are specifically manufactured for enterprise use aren't any more reliable than those made for the mass consumer market. The report looked at failure rates within the business itself and found the lifespan of hard drives used in this type of data centre to be under three years in almost all cases. **HD**

## Bill Gates building 'smart city' in Arizona desert

### Welcome to Belmont.

**Bill Gates has invested US$80 million in the building of a smart city outside Phoenix, Arizona. The city, to be built on 24,800 acres of land, will consist of 80,000 homes, with over 4,000 acres reserved for industry, office, retail space and schools, with another 3,400 acres set aside for open spaces. The proposed city will be called Belmont and "will create a forward-thinking community with a communication and infrastructure spine that embraces cutting-edge technology, designed around high-speed digital networks, data centers, new manufacturing technologies and distribution models, autonomous vehicles and autonomous logistics hubs," Belmont Partners said in a statement. Not much else is known about the project, including when the foundation work will begin.**

This isn't the first time we've heard of a smart city being planned. In October, Google spin-off company Sidewalk Labs struck a deal to convert 800 acres of Toronto into an "internet city", with public Wi-Fi hubs, self-driving cars and other modern technologies to revolutionise city living. **Sharmishta Sarkar**

## Intel and AMD team-up aims to tackle Nvidia's mobile GPU dominance

BUILDING A BRIDGE OVER TROUBLED WATERS.

Intel and AMD have historically been bitter rivals, but the two chipmakers have come together to take on the competition from Nvidia. The partnership will see AMD's graphics chips combined with Core H series processors to produce a multi-chip package to be sold under the Intel banner. This new addition to Intel's 8th-generation processor line-up would be the first to use high bandwidth memory (HMB2) in mobile PCs and is intended for thin laptops powerful enough to satisfy any serious gamer.

Intel's Christopher Walker explained that "it's a prime example of hardware and software innovations intersecting to create something amazing that fills a unique market gap". AMD also released a statement saying that, "Together, we are offering gamers and content creators the opportunity to have a thinner-and-lighter PC capable of delivering discrete performance-tier graphics experiences in AAA games and content creation applications."

No launch date has been set, but the partners hope to have the chip ready in the first quarter of 2018. **Sharmishta Sarkar**

## Domino's Pizza's Australian customer database has been leaked

RECEIVE A FREE SCAM EMAIL WITH YOUR PIZZA.

Domino's Pizza recently had its Australian customer database leaked, with scammers having obtained at least names, email addresses and locations where the pizza was bought. Several customers then received phishing emails which seemed legitimate, with the customers being addressed on a first-name basis and a mention of their suburbs. The pizza chain has blamed the breach on a former supplier and has apologised for the "unauthorised access" to personal information. SS

## Searches for TV shows and movies on Netflix beat pirate alternatives, says Google

MORE WAYS THAN ONE TO GET YOUR ENTERTAINMENT.

It's something that's been said a lot — make TV shows and movies more accessible and piracy will reduce. To test that theory, Google undertook a study in one of the world's hottest piracy spots, Brazil, and found that streaming services like Netflix are giving people access to interesting libraries on easy-to-use platforms, thus spreading awareness that there are alternatives to piracy. Netflix isn't necessarily reducing piracy itself, but users seem to be "extremely satisfied" with the service. SS

## Aussie tech retailer MSY levvied massive fine – again – for misleading consumers

DINGED FOR $750K OVER WARRANTY CLAIMS.

Tech retailer MSY has been slapped with a $750,000 fine by the Australian consumer watchdog ACCC for misleading customers on product warranties. And this isn't the first time either. In 2012, the retailer — which runs 28 stores across the country, plus an online shopfront — was fined $203,000 for practically the same reason. It has come to light that MSY amended their terms and conditions after ACCC sent a letter back in 2010, but these were removed by early 2013, and reinstated back again only in February 2016. SS

# Motion Picture Association of America warns Australia not to mess with geoblocking

## Should VPNs be officially allowed to bypass content region locks?

**In a recent response to an official Productivity Commission report, the Australian Government endorsed the use of VPNs for Aussie consumers wanting to gain access to geoblocked media content, stating that doing so could help to reduce piracy. The MPAA (Motion Picture Association of America) has responded, firing off a stern warning against the adoption of any such laws and claiming that the whole proposal shows "a breathtaking lack of understanding of longstanding international norms and the importance of copyright to Australia's creative industries".**

It's perhaps unsurprising that Hollywood isn't so keen on some of these laws getting passed. Australia is currently paying more than most other regions for its streaming content and in many cases is getting it much later, so circumventing geoblocks allows Australians to access movies and shows at the same time as other territories, and often unlocks content that would otherwise not have seen a local release.

The Australian Government thinks that giving the public "affordable access to copyright content in a timely manner is a key factor in preventing copyright infringement", pointing out that users who do bypass geoblocking already pay for the service, but that those users would possibly resort to piracy if the media was legally unattainable. **Harry Domanski**

## NBN may never make a profit, the CEO warns

MALCOLM TURNBULL WEIGHS IN.

The CEO of NBN CO, Bill Morrows, has claimed that, unless the service is protected from the threat of mobile broadband and the competition this poses, it will never make a profit. In an interview with *Sydney Morning Herald*, Morrows explained that, while they currently earn around $43 a month for an average connection, this number needs to climb to $52 before they can even start recovering costs.

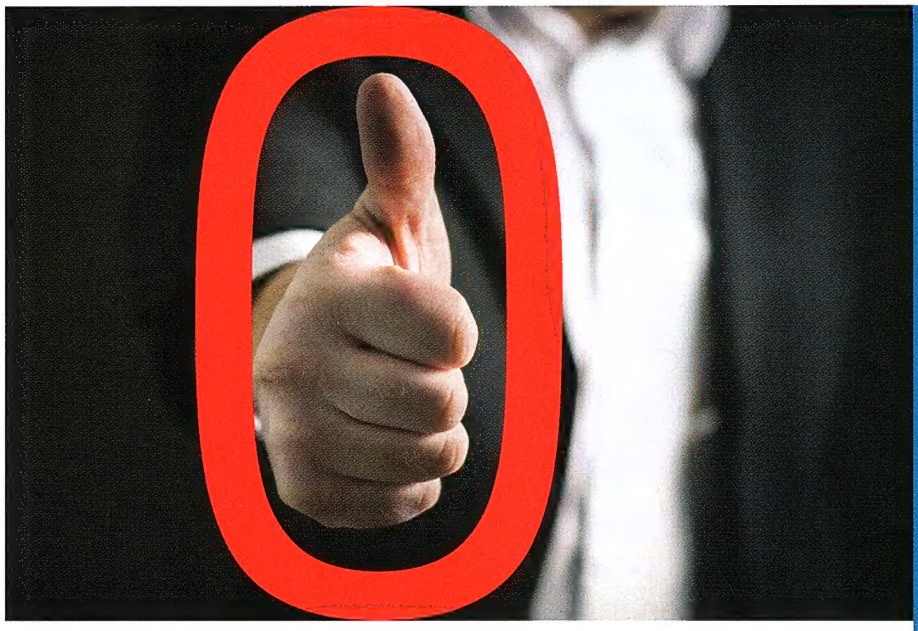
"Forget about 5G," Morrows began, "even the antenna technology using 4G is a viable alternative to NBN where the towers are already up."

There is currently a levy in place that charges fixed-line competitors a fixed monthly rate in order to subsidies the NBN rollout to locations that are difficult to connect, but Morrow is concerned that this levy doesn't apply to wireless solutions.

Prime Minister Malcolm Turnbull has added his two cents to the issue in a public statement, admitting that the NBN will never make the profit that was initially expected, unsurprisingly blaming the opposition government for leaving the Liberal Party with a "calamitous trainwreck of a project when they came into government". **Harry Domanski**

# numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS



## 0

THE NUMBER OF F*CKS ISPs GIVE ABOUT DELIVERING GOOD NBN SERVICE

According to NBN Co board member and founder of iiNet Michael Malone, most Aussie internet service providers (ISPs) "don't give a f*ck about the quality of [NBN] service" they deliver, instead "the reason they are moaning is that they are price fighting". In the interview with Fairfax Media, Malone very much pointed the finger at the ISPs, rather than NBN Co itself, when it came to where the blame should be laid for slow NBN speeds.

## 28th

AUSTRALIA'S RANKING AGAINST 27 OTHER COUNTRIES IN A SURVEY OF GLOBAL BROADBAND SATISFACTION

The bad news for the Aussie 'net keeps rolling in, with an annual Global Advisor survey conducted by Ipsos finding that Australians are more unsatisfied with their broadband than any of the other 27 countries that participated in the survey. With only 32% of those surveyed rating our country's broadband as either 'fairly good' or 'very good', we've fallen behind Italy and Brazil in broadband satisfaction as this figure nears half of the global average, which reflects 56% of a country's residents being satisfied with their broadband.

## 200

AMOUNT OF PASSWORDS THE AVERAGE GLOBAL EMPLOYEE MANAGES

Password management company LastPass has conducted research into password usage around the globe, and has found that the average employee is expected to manage around 200 of the annoying buggers at once, and that we waste an average of 36 minutes a month typing them out. An alarming 61% of those surveyed revealed that they re-used passwords, despite nearly all of them being aware of the risks, with users' fear of forgetting passwords far outweighing their fear of being hacked.

## 215 kWh

AMOUNT OF POWER USED BY A SINGLE BITCOIN TRANSACTION

As of November 1st, cryptocurrency analysis website Digiconomist estimates that over 24 terawatt-hours of electricity are consumed annually in Bitcoin mining efforts, which boils down to around 215kWh per transaction. Considering the average Australian household uses under 16kWh per day (according to Ausgrid's 2016 data), this means that a single Bitcoin transaction could power an Australian home for almost a fortnight.

## 15,000

NUMBER OF CHROMEBOOKS THE ACT LOCAL GOVERNMENT HAS BOUGHT FOR ITS STUDENTS

ACT Education Minister Yvette Berry has announced that the local government has purchased 15,000 Acer Spin 11 Chromebooks for its students. The initiative was put in place to equip students from years 7–11 with the means for a fair education in the modern age. The Spin 11 was designed specifically for educational purposes, with an 11.6-inch touchscreen that can rotate on its 360° hinge to transform into a tablet.

# techbrief

» CARMEL SEALEY WADES INTO A CURRENT NEWS TOPIC TO TAKE A CLOSER LOOK

# Nostalgia for tech

## Why do retro brands and products set our hearts aflutter?

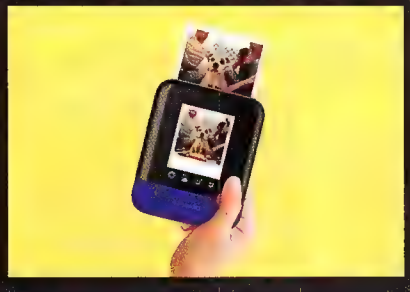
Tech nostalgia, it is argued by some, is far from a harmless bit of fun – it is a symptom of a serious problem in the tech industry: the lack of innovation. When high-end smartphones get released year after year with only minor tweaks to design, it's easy to understand that some consumers would begin to feel a little disenchanted and yearn for something drastically different. Of course, you could argue that certain technologies develop to a certain stage before they plateau, becoming something akin to 'perfected' before the next technology supersedes it (mobile phone design, for example), but what does it mean for technological advancement, when companies decide against taking risks and producing something new, and instead simply churn out their old popular models – slightly tweaked – over and over? Is nostalgia really an unhealthy black hole for the tech industry and the future of innovation? We here at *APC* are not as doom and gloom about this subject as some, taking the more optimistic 'Why not both?' stance. So let's have a look at the recently released products that aim to tickle our nostalgia glands.

### Sony Walkman

The Sony Walkman has been trying to 'do a phoenix' for the last five years or so, but in a world dominated by smartphones that can hold thousands of songs (and access thousands more, thanks to streaming), the company truly is fighting a losing battle. The pinnacle of this insanity came in September of last year when Sony released a gold Walkman that costs just US$3,680.

### Tamagotchi

2017 marks the 20th anniversary of everybody's favourite virtual pet, the Tamagotchi. Chances are, you know someone who had one or maybe had one yourself. Needless to say, this egg-shaped device is much the same with its pixelated screen, few buttons and blob-like pets that need your love and devotion. Will it survive for another 20 years? Probably not, as there's an app version, of course.



### Polaroid Pop Instant Digital Camera

CES 2017 featured a lot of useful tech that has since successfully released. It also featured the Polaroid Pop, the latest instant-print camera from the company who had, in 2008, apparently dropped that technology. While its design is clearly updated over those that were around in the '90s, the tech is no less obsolete in a smartphone-ruled world. When was the last time you ever wanted to print a photo? Yeah...

### NES Classic Edition console

Some companies, however, get it spot on. If Nintendo knows how to do one thing, it's nostalgia. Its *Mario* universe is built on that mighty foundation, after all. So why has it worked? The difference probably lies in the strength of the included games themselves — they're just as playable now as they were back when they originally released in the late '80s. *Super Mario Bros, The Legend of Zelda, Donkey Kong, Mega Man 2, Final Fantasy, Metroid*... need we say more?

### Nokia 3310

Your humble writer put off getting a phone for many years, so the buzz around the 2017 Nokia 3310 release (re-release?) is something that, honestly, goes over her head. Back in February at Barcelona's annual Mobile World Congress, the Finnish company announced the resurrection of the 17-year-old phone, which sports a 2MP camera, 2.4-inch curved colour screen and a revamped version of *Snake*. You can even do a bit of web browsing. It comes with 3G connectivity and Bluetooth, plus headphone jack. Its UI and design is very retro, and the whole bundle will cost you just $89. We know a few people who would pay that much for *Snake* alone...

# gadgets

» GEAR WE WANT

## SPHERO R2-D2

A tripod for your Star Wars addiction.

**$299 | WWW.SPHERO.COM**

Sphero's 2015 BB-8 was a massive hit in the robotic toys market, which cleverly coincided with the *Star Wars* character's initial appearance in *The Force Awakens*, the first film in the new trilogy. As we near the second film's release (and, of course, Christmas), Sphero has announced a similar first-appearance character tie-in with the launch of a Dark Side's droid character called BB-9E. For long term *Star Wars* fans, however, Sphero's additional release of an R2-D2 is probably going to be the more exciting new 'bot. R2-D2 is the first Sphero droid to feature a speaker that allows you to directly interact with it, and it'll carry over the original BB-8 toy's abilities of being able to watch the films alongside you and play augmented reality games. **JB**

## HTC VIVE FOCUS

There's competition for the Oculus Go as the standalone VR race heats up.

**PRICE & RELEASE DATE TBA | WWW.VIVE.COM**

At HTC's recent Vive Developer Conference in Beijing, the company finally got to show off its upcoming standalone headset to the crowd — a device it's calling the Vive Focus. Designed to tread the lines between power, portability and affordability, the Focus is an all-in-one headset that won't need to be hooked up to a PC or smartphone in order to run, and won't have the same interactivity constraints that mobile VR currently has. The headset will feature an AMOLED display and is powered by a Qualcomm Snapdragon 835 CPU and will be capable of 'world-scale' tracking — the name HTC is giving to its inside-out 'six degrees of freedom' (aka 6DoF) tracking. This allows for the detection three-dimensional movement and rotation in any environment, with no need for additional external sensors. **HD**

## RAZER PHONE

Cutting into the portable gaming market.

**US$700 | WWW.RAZERZONE.COM**

Let's hope Razer puts a little more effort into the construction of its latest smartphone than it did in landing on a name. The 'Razer Phone', as the company is calling it, is intended to deliver the ultimate Android gaming experience by integrating novel tech like a quad-HD 120Hz UltraMotion display, GPU-screen synchronisation, a ridiculously high 8GB of RAM, a 24-bit digital audio converter and a 4,000mAh battery. These additional gaming perks come alongside the more expected flagship-smartphone features of a Qualcomm Snapdragon 835 processor, a dual 12-megapixel rear camera and a sleek 8mm profile. It should make a particularly compelling offering for anyone who likes Android gaming... but there's no word on a release outside the US at this point. **JB**

## SONY AIBO

Digital doggy returns.

**~$2,300 | AIBO.SONY.JP/EN**

Aibo's back! How much is that doggy on the internet? A lot. In fact, you could buy an actual French Bulldog for the Sony Aibo's asking price. However, not all of us are set up to care for a real puppy, making the Aibo a surprisingly sweet alternative. Sony has 'bred' a few robot dogs over the years, but the 2017 version looks to be the most charming litter yet.

Thanks to deep learning and AI tech, Aibo can detect smiles and words of praise to learn what makes you happy. In return, Aibo enjoys lots of back and head scratches, and will come find you for playtime. Before you bust out the dog bed, though, you might want to investigate getting a doggy passport — Aibo is currently only for sale in Japan, so customers Down Under will have to import this cute robot doge. Aibo was genuinely iconic, and we hope this new version gets a worldwide release.

## TELSTRA TV 2

Where all your 4K streams come true.

**$192 | WWW.TELSTRA.COM.AU**

If you've bought a 4K TV recently, you'll likely have noticed that it provides access to a few selected partner streaming services, but that no 4K sets yet offer compatibility with all the local streaming services and catch-up TV offerings. While the Telstra TV 2 is exclusive in other ways (you technically need a Telstra ID to be able to buy one, although it's easy to sign up for one of these for free), it does solve the problem of ubiquitous content, allowing access to all the most prominent local and international streaming and catch-up TV services. Released in November 2017, this updated model adds a live-TV aerial input and 4K HDR output to its 2015 predecessor, letting you stream at the highest currently-available qualities. **JB**

## LOGITECH BRIDGE KIT

Keying in to VR.

**US$150 | WW.VIVE.COM**

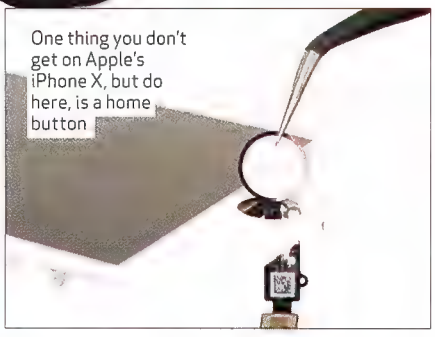
Logitech is pretty good at pushing the boundaries of gaming peripherals, but even by its standards, we were surprised to find that it's been working with HTC on an integrated 'VR keyboard', with a real-world keyboard that's accurately replicated and tracked in the virtual world so you can 'see' it while wearing a VR headset. The resulting Bridge Kit will see a limited initial release of 50 starter kits that are being made available to developers building applications in VR. We can't help feeling these keyboards would be a massive perk for anyone playing VR games, too. That said, while a dedicated VR keyboard is a neat proposition, it'd be even better if HTC and Logitech could simply create a tracker for your existing keyboard (and mouse)... **JB**

# howit'sdone

# Apple iPhone 8

## Taking it apart to get at the core.

The iPhone 8 has a smaller battery than its iPhone 7 predecessor.



One thing you don't get on Apple's iPhone X, but do here, is a home button

**Time to find out whether Apple's merely playing numerical catch-up to Samsung's Galaxy S8 line, or if glass backing and wireless charging warrant skipping ahead an 'S' upgrade.**

### MAJOR TECH SPECS

- A11 Bionic chip, with embedded M11 motion coprocessor
- 64GB or 256GB onboard storage
- 4.7-inch IPS multitouch 1,334 x 750 (326 ppi) Retina HD display
- 12MP camera with f/1.8 aperture, optical image stabilisation and 5x digital zoom
- 7MP FaceTime HD camera with f/2.2 aperture and 1080p HD recording
- Support for fast-charge and Qi wireless charging
- 802.11a/b/g/n/ac Wi-Fi, MIMO, Bluetooth 5.0 and NFC

### KEY FINDINGS

- Features include a solid-state home 'button', with Touch ID fingerprint sensor and an IPS display, similar to the one in the iPhone 7 (but now featuring True Tone). On the back, we spy the snazzy new glass backing, with its seven-layer colour finish. Apple assures us that it is reinforced with "an internal laser-welded steel and copper structure", but time and durability tests will tell if this phone will suffer from a snap, crackle, pop – or another Bendgate.
- As we crack open the display, we are greeted by the display cable bracket, but instead of the cursed tri-point screws, we're met by friendly Phillips #000 screws! We decouple a few cables – battery, display and home button – and the display is free! We note a lack of gaskets on the display's pentalobe tabs, previously seen in the iPhone 7. However, both the iPhone 7 and 8 have an IP67 water resistance rating.
- A new Lightning port bracket seems to reinforce the new peach-coloured port and trap the Taptic engine. In removing this bracket, we encountered our first tri-point screw. We suspect the coloured Lightning port could be made of a heat-transferring plastic to allow for safer fast-charging.
- We take a stab at separating the rear glass, but instead shivved our way under the reinforcement panel. After more arduous stabbing, we get the seven-layer burrito glass sandwich off the midframe. This isn't what we thought Apple meant when it said the glass was stronger. The process left the backing plate a bit bent.
- **Repairability Score:** 6 out of 10 (10 is easiest to repair). The two most commonly replaced components – display and battery – remain straightforward to access with the proper knowledge and tools. Wireless charging means less strain on your Lightning port, a common point of failure. Water and dust seals complicate repair, but make the need for difficult liquid-damage repairs less likely. The battery connector sports common Phillips/JIS fasteners – but you do need up to four different driver types for many repairs. Replacements for the glass back are likely to be very difficult to come by. The iPhone's lower components, once readily removed, now lie trapped under a fussy combination of brackets and delicately folded flex cables. ■

### About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit: **www.ifixit.com**

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# epinions

## YOU SHALL NOT PASS

I like the idea of password managers but worry about getting locked out of everything if I somehow forget my master password. If I do, then all my other passwords will be lost!

I have tried LastPass but could not persevere as it did not appear as simple as anticipated.

**Geoff Kemp**

## PASSING THE TEST

I read the Editor's piece in *APC* 447 (see page 3) and downloaded and installed a password manager but cannot sort out what to do next. The user manual does not help and there is no support as far as I can see. Your help would be appreciated.

Do I have to re-password the dozens of sites I now have accounts with?

I have been playing with computers for years but on this one I am really dumb. Please help.

**Keith Males**

**Ed replies:** *These were just a couple of the emails we received about password managers after our recent coverage. As we've previously espoused, we reckon it's definitely worth switching to using one over trying to remember all your passwords yourself – or worse, re-using the same password across multiple sites, or writing them all down where anyone can find them.*

*However, if you've never used a password manager before, there definitely is a bit of an adjustment period. You'll have to re-do your passwords for the sites you currently log onto, for a start – sorry, Keith – but we'd suggest being a little kinder to yourself and do this on a case-by-case basis, generating a new password for each site/service you use when you first login to them for the first time – it's a bit too painful to attempt as one big job.*

*When it comes to specific mechanics of how to use a password manager, if you've signed up for LastPass, you don't actually need to install the dedicated app if you're on Windows or Mac. The easiest way to use it is to install the dedicated browser plugin, after which you'll get a little icon on any login fields that appear on a web page.*

*Clicking that icon gives you a few options: if the login details are saved in LastPass, it'll automatically fill them in for you; if you type in a login and password that's not in your vault, you'll be prompted to save them; if you're signing up for an account, you can click the icon to generate a new secure password.*

*It's pretty straightforward once you've used it a couple of times – like most software, the hardest part is that initial hurdle – learning how it works – afterwards, it becomes second nature, and you'll be rewarded by peace of mind.* ■

"When it comes to specific mechanics of how to use a password manager, if you've signed up for LastPass, you don't actually need to install the dedicated app if you're on Windows or Mac."

APCMAG@FUTURENET.COM

## Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

# end user

» SHAUN PRESCOTT DIGS INTO THE BIG TECH ISSUES AFFECTING CONSUMERS

# Social media can't handle the truth

Current efforts to curb the dissemination of fake news are half-hearted, Shaun Prescott writes.

**Once upon a time, the term 'social media' described websites where we shared baby photos, movie opinions and other banalities with our friends. But now, platforms like Facebook and Twitter are more consequential – politically and socially – than their creators often care to take credit for. The most stunning example is the reports that Russia sought to influence the 2016 US election with propaganda and misinformation, distributed via Facebook. In the wake of that election, platform holders like Facebook were pressured to assess how such 'fake news' was being spread and whether it could be curbed.**

It's a gigantic, seemingly insurmountable challenge, but the company made a fuss about taking action. In partnership with organisations such as Snopes and the Associated Press, Facebook does moderate the millions of stories posted on the platform, although according to a recent *Vanity Fair* report, those responsible for the process don't have much faith that it's working. In the words of one anonymous fact checker working on the vetting project, "I don't feel like it's working at all. The fake information is still going viral and spreading rapidly... It's really difficult to hold [Facebook] accountable."

Fake news isn't just about conniving political orchestrations – it's also very lucrative. Take, for example, recent reports of a whole scene of content creators in Veles, Macedonia, who, for the benefit of advertising dollars, created deliberately provocative (and inaccurate) pro-Trump content in the lead up to the election. While this predates the election by some years, it's significant because this purely for-profit enterprise saw the proliferation of politically charged material which social media audiences lapped up. Clicks are big business, and traffic from Facebook is where most of these clicks come from.

According to the source speaking to *Vanity Fair*, Facebook's attitude seems to be this: as long as we appear to be doing the right thing, we're doing the right thing. In other words, the company's arrangements are little more than PR fluff, and the effectiveness of their current systems are low. "They think of us as doing their work for them," the source said. "They have a big problem, and they are leaning on other organizations to clean up after them."

Of course, Facebook knows exactly how powerful its platform is – it hasn't stumbled into this, it's not a bumbling fool. It's alarming that canny organisations, governments and even individuals are capable of wielding such enormous political influence on such a public platform, but consider this for a moment: what are Facebook's own political goals? And are they already working towards them? With the amount of power and heft accumulated by Silicon Valley this past decade, corporations like this are more consequential than ever before. ■

END USER

## Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

# Head to head: Hard drive technologies

Jeremy Laird pits the magnetic hard drive against SATA SSD and M.2 NVMe technologies in a head-to-head battle to discover which one is superior.

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WD Green
Desktop Hard Drive

**Storage was once the final frontier of PC performance, and the last component to become fully solid state. Today, the latest M.2 SSDs powered by the new NVMe protocol and hooked up via zappy PCIe connections deliver performance that a conventional hard drive wouldn't recognise. Yet the hard drive isn't dead. Not when it offers so much capacity for so little money. Meanwhile, the trusty SATA SSD offers a combination of compatibility and speed that's awfully compelling. Time to find out which storage technology is the best.**

## Round 1

**PERFORMANCE**

You might think the choice between old-school magnetic drives, conventional SATA SSDs and the latest M.2 items was a total no-brainer. For the most part, you'd be right. Magnetic drives, with their quaintly spinning platters and delicately servo'ed read heads, certainly don't stand a chance when it comes to raw performance. They're OK at sequential workloads, albeit offering about one tenth the speed of a decent SSD at best, but they really suck when it comes to random access.

SATA SSDs, meanwhile, may be pretty quick, even by modern standards, but they're ultimately held back by both the SATA interface itself, which caps peak performance at about 550MB/s, and the elderly AHCI control protocol, which was never intended to be used with solid-state tech.

So it's M.2 and its zippy PCI Express interconnect that easily rules the day, with the latest drives topping 3GB/s for peak performance, and packing the highly optimised NVMe control protocol. The catch is system compatibility, and that's why M.2 isn't a complete no-brainer. Especially for older PCs, a SATA SSD may be the most painless path to decent storage performance.

WINNER:
M.2 NVMe

## Round 2

**CAPACITY**

Spare a thought for the poor old conventional hard drive. In this brave new age of solid-state computing, the very notion of moving parts seems utterly antediluvian. But this is its chance to shine. When it comes to raw storage capacity, those spinning magnetic platters positively annihilate the solid-state alternatives.

Perhaps most impressive is the fact that, while CPU performance has somewhat stagnated, and the power of Moore's Law to predict chip shrinkage may well have stalled, the ability of magnetic hard drive makers to pack in even more capacity hasn't waned at all. Innovations such as the use of helium to reduce internal air shear saw the 10TB barrier cracked last year in the consumer drive space, and that progress looks set to continue, albeit at quite a price.

Aim a little lower, and the likes of a 3TB drive are now available for as little as $125 – and even less if you're willing to roll the dice on a refurb.

The only caveat is that, if you don't have a big video or games library, you probably don't need a big hard disk at all, and a much nippier budget SSD of around 500GB is probably all most mainstream users will ever actually need.

WINNER:
Magnetic hard drives

## Round 3

**COMPATIBILITY**

Given the radical change in technology represented by solid-state storage, it's surprising that it wasn't accompanied by major compatibility problems. However, thanks to adopting existing standards, including the SATA interface and support for legacy IDE and AHCI control protocols, SSD compatibility has been, for the most part, a breeze. SATA ports have been standard on nearly all motherboards for a very long time.

So whether your SATA drive is solid state or magnetic isn't hugely consequential in compatibility terms. But things get more complicated when it comes to those newfangled M.2 drives. Any motherboard more than two years old almost certainly lacks an M.2 port. What's more, having an M.2 port doesn't automatically mean support for the highly desirable NVMe control protocol.

Granted, it is possible to buy M.2 PCI Express adapter boards to add support to legacy motherboards. But the older your mobo, the more likely it is to have issues supporting booting from the drive and, again, that NVMe protocol. It's also worth remembering that your M.2 drive will only be as fast as the PCIe lanes provided by the motherboard.

TIE:
Magnetic hard drives and SATA SSDs

"Before you splash out on a new storage device, think about whether your priority is speed, cost or a balance of the two, then take your pick."

## Round 4

**VALUE**

What price do you put on capacity or performance? That's the conundrum you face when sizing up the value of the various storage options. You cannot maximise both attributes. Solid state prices have come down, but when it comes to GB/$, they're still obliterated by traditional magnetic storage.

A $125 3TB hard disk, for instance, works out at around 24GB per dollar. Matching that capacity with an SSD will cost you roughly 10 times as much. For example, at the sweet spot of current SSD GB/$, which is probably the 1TB segment, you can get roughly 2.5GB per dollar. And that's for a budget-oriented SATA SSD. The fanciest M.2 drives are even worse in terms of value.

Of course, shift your priorities toward performance, and the tables are resolutely turned. When it comes to random access performance, which is especially critical for everyday performance and responsiveness, SSDs can be over 100 times faster than magnetic drives. That said, the cheaper end of the SATA SSD spectrum probably gives you the best bang for buck. But take care to avoid the very lowliest, which often use cheap controllers intended for USB drives, to save money.

WINNER:
SATA SSDs

## Round 5

**DURABILITY**

This is the most contentious metric. Firstly, that's because durability can mean different things. For a portable PC, a solid-state drive is a huge bonus, and has the potential to be far more robust than a fragile magnetic drive, with spinning platter and moving read heads.

For a desktop PC, where physical shocks and exposure to extreme temperatures are less common, durability is all about the ability to soak up a lot of bandwidth, without losing performance and capacity, or failing.

The early days of SSDs were grim in that regard. Outright failure wasn't that common, but a drop-off in performance was inevitable over time. Six months of heavy use could truly hammer those first SSDs. Since then, multiple technologies, including advance wear leveling and garbage collection routines, have dramatically improved the situation. Of course, the performance of hard drives can go off over time, too, with data fragmentation. But that's usually fixable with a little defragging.

Overall, however, the very best M.2 SSDs can be had with warranties and life expectancies of around five years, even with very heavy workloads. On balance, they're probably now the most robust storage technology.

WINNER:
M.2 NVMe

## And the winner is...

Call us indecisive, but the final verdict on which storage medium is best really has to come down to your own personal usage model. If you want to maximise sheer capacity, for instance, a conventional hard drive is an absolute no-brainer. It's literally an order of magnitude cheaper. Even if money is of no consequence, one can only connect so many drives, and hard disks are simply bigger.

On the other hand, if performance is your exclusive priority, then one of the latest M.2 SSDs with support for the NVMe protocol should be your weapon of choice. These solid-state devices now deliver performance measured in gigabytes per second, which you have to admit, is pretty stunning.

However, perhaps the best overall compromise of value, performance and compatibility for now is an SSD hooked up via the good old SATA interface. It's a fantastic way to give and ageing PC new life.

So before you splash out on a new storage device, think about whether your priority is speed, cost or a balance of the two, then take your pick. ■

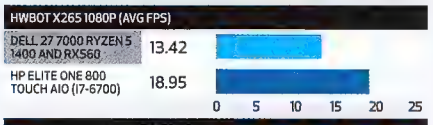
ALL-IN-ONE PC

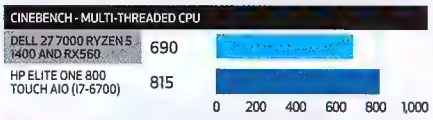
**RYZEN 5, FROM $2,299; RYZEN 7, FROM $2,799 | WWW.DELL.COM/AU**

LABS BENCHMARK RESULTS

General performance

Media encoding performance

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HP ELITE ONE 800 TOUCH AIO (I7-6700)
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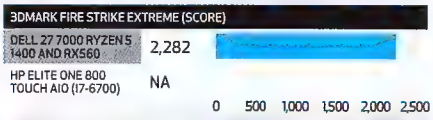
Gaming performance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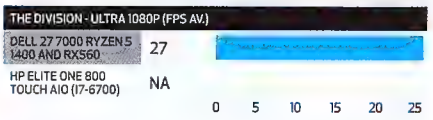



# Dell Inspiron 27 7000 (2017)

## Dell puts it all on red.

**Dell's Inspiron 27 7000s haven't been the most inspiring all-in-one PCs since they launched a couple of years ago, but with not a lot to lose, the company's gone a little radical in its search for the next big thing. It's done so by betting big on AMD components, throwing out the Intel parts and going all-in on an AMD Ryzen CPU and Radeon GPU combo. This transition has added a dedicated GPU to the 27-inch AIO equation, meaning these new models finally pack some real gaming grint. However, these new Inspirons have consequently started to line up with Apple iMac's 'premium' price points. So can Dell compete in this space?**

We tested the midrange model that's currently available through JB Hi-Fi, but it's not a configuration we think is particularly well balanced. It's been fitted with the amply-powerful Ryzen 5 1400 and 8GB of DDR4 RAM, but these premium components have to make do without an SSD, and relying on a 1TB HDD drags everything from boot times to file transfers down to an excessively sluggish pace for such a premium machine.

That said, cough up $100 more and you get a config with an additional 128GB SSD to run your OS and some essential apps, so it's probably best to just pretend that this $2,199 model isn't an option.

AMD's streamlined Ryzen 5 series CPUs actually perform pretty close to a number of Intel Core i7 chips, with the Ryzen 5 version of the Inspiron 27 7000 lining up roughly with the performance of an i7-6700HQ, a staple CPU in high-end gaming laptops from the first half of this year. It even managed to get ahead of a desktop i7-6700 CPU that we tested on an HP EliteOne 800 Touch AIO in PCMark 8's Home benchmark, with a score of 3,840 over the latter's 3,528. However, it fell behind on the Work element, with respective scores of 4,528 and 4,997.

Fitted with a Radeon RX 560 GPU (roughly the same as a mobile GeForce GTX 1050), the 27 7000 is capable of light gaming and gets above 30fps using Ultra settings in titles like *Batman: Arkham Knight*, *Bioshock Infinite*, *Grid 2*, *Metro Last Light* and *Tomb Raider*. For more recent titles like *The Division*, you'll have to turn the settings down to Low in order to get 1080p to run at more than 60fps.

While light gaming is doable on the model we tested, if you're considering using it for games, we reckon it's worth paying the extra $400 for the Radeon RX 580 configuration, as it's considerably more powerful and it comes with a 4K screen to boot.

To be honest, we were expecting more from this midrange 27 7000, and since the thermals of the CPU didn't get above 71°C and the GPU peaked at 61°C across our entire testing period, there was arguably some room for clock speeds and performance to be boosted higher.

The big, near bezel-less screen is tapered across the bottom edge by a stylish soundbar that both looks and sounds great and goes some way to redeeming the speed shortfalls.

At the time of writing, all models were on a 15% discount, which brings the top tier model to an intriguing price point at $2,379. At full price, though, these units are less competitive than we were hoping for. ■ **Joel Burgess**

### Verdict

Features ★★★★½
Performance ★★★½
Value ★★★½

**A powerful AIO device, but its off-the-shelf AMD components make it more expensive than it should be.**

★★★½

LAPTOP

**FROM $1,699 | WWW3.LENOVO.COM/AU**

# Lenovo IdeaPad 720S

## A compact laptop with plenty of power.

**Lenovo hasn't thrown traditional laptop design out of the window with the IdeaPad 720S, but this is far from a run-of-the-mill machine. If anything, the 720S seems poised for a bare-knuckle battle with Dell's slightly-dinkier XPS 13, one of the best all-round laptops in the world.**

It has a similarly slim bezel design, comparatively compact, luxurious frame, and even goes one better than the XPS 13 with a discrete graphics solution on board. But does it punch above its weight?

The IdeaPad sits in the mid-range bracket in terms of its cost, starting from $1,699. There's a few different configs on offer, and we tested a midrange Core i5 for this review.

Despite its 14-inch display, the 720S is incredibly compact — a heavily reduced slim bezel means you get more machine in a lot less space.

The reduced keyboard has a few compromises; while it's neatly backlit, it stuffs the directional arrows into the space of three keys, and inexplicably includes the power button as a keyboard key directly next to Delete and Backspace. It's not instantly triggered on pressing, so this isn't as boneheaded as it sounds, but still an odd design choice.

There's a large multi-touch trackpad, fingerprint sensor, and just enough ports that it doesn't seem neutered. The aluminium case is clearly squashing some serious hardware inside, as the 720S weighs in at a not inconsiderable 1.55kg. It's not back-breaking, but definitely unusually weighty for a laptop of this size.

One thing seems to play off against another on the IdeaPad 720S. On the one hand, the IPS screen has tremendous viewing angles; on the other, it tops out at a resolution of 1,920 x 1,080. Yes, we're being picky.

There's also a decent JBL-engineered, Dolby-infused sound system on board, with surprising audio thickness for such a diminutive laptop, but you'll often struggle to hear it over the wind tunnel blast of the infernal fan cooling system. It's one of the loudest laptops we've ever used when under stress. To be fair, that cooling really works — the 720S barely even gets warm to the touch — but it whirrs at an irritating pitch.

It's easy to find fault with the IdeaPad before even using it. The 256GB SSD space, with no additional storage on board, is going to fill up very quickly. It has discrete graphics but, as our benchmark results show (achieving just 12.4fps when running *Total War: Warhammer* at 1080p Ultra and 2.4fps on *Deux Ex: Mankind Divided* at the same setting), the Nvidia GeForce 940MX can't keep up with modern gaming.

But as a package, this thing is nice. It's a great machine on the desktop. It's slick and efficient to use, it's perfect for media and working on the move, and that Kaby Lake processor is an impressive number cruncher.

The battery lasts a typical 3.5 hours — a disappointing result. That time drops even lower if you're gaming. Drop the brightness and stop hammering the CPU, though, and you'll get a bit longer out of it.

If you're looking for a gaming laptop, there are beefier, uglier machines at this price point. If you're more of a worker, there are lighter machines with larger screens that might suit you better. But if you fall in the middle of those two camps, you won't be disappointed here. ■

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★☆ |
| Value | ★★★★½ |

A tight bezel, decent CPU and dedicated graphics — all crammed into an impossibly tight case. Nice.

★★★★☆

apc RECOMMENDS

LAPTOP

$1,799 | WWW.ASUS.COM/AU

# ASUS VivoBook S15 (S510UQ)

## An average laptop for the average user.

**With a starting price of around $1,799, this is a moderately-priced laptop that's sure to attract attention from students and the casual user. It's powerful and has a large display, yet is still portable enough to tote around in a backpack.**

The plastic base is a mirage. Its brushed finish gives the impression it's a metal housing from afar. It's only after you pay closer attention that you realise the optical illusion, designed to match the laptop's aluminium lid.

The slight taper from the hinge to the front of the housing is reminiscent of Apple's MacBook Air. Weighing in at 1.5kg, the VivoBook is slightly heavier than the Dell XPS 13 (1.29kg). Overall, it feels solid, with its combination of plastic and aluminium keeping it affordable without sacrificing looks.

You're unlikely to run out of places to plug in your accessories here. The left side is where you'll find both USB 2.0 ports and a standard SD card reader. On the opposite side is the 3.5mm audio jack, a USB-C port, full-size HDMI, USB 3.1 and the DC charging port.

Surrounding the 15.6-inch, 1,920 x 1,080 Full HD display is a narrow bezel, measuring just 7.8mm, what ASUS calls its 'NanoEdge'.

As with the ZenBook 3, the fingerprint reader is located in the top-right corner of the trackpad. Fortunately, here, it's tucked further into the corner than it is on the ZenBook, making it easier to use the trackpad without the fingerprint reader interrupting swipes or other gestures. We'd still prefer not to have it on the trackpad, of course.

The VivoBook is a dream to use. It keeps up with any task you put it up against, and you're unlikely to notice any significant slowdowns or over-zealous fans to keep it cool.

Where the VivoBook struggles most is with its battery life, lasting just 3 hours and 12 minutes during our PCMark 8 battery benchmark test, compared to the Dell XPS 13's 4 hours and 3 minutes. The results of our movie test were even starker, with the VivoBook on 5 hours and 48 minutes, compared to the XPS 13's 7 hours plus.

The touchpad is set up with both left- and right-click sections, separated by a line in the middle of the plastic-covered touchpad. This isn't an uncommon setup, but here, it's frustrating to discover just how finicky the invisible sections are, resulting in frequent errant right-clicks. You can disable right-click in the lower-right corner of the touchpad in Windows 10's Settings, though.

The keyboard is merely average, with adequate spacing, and suitable travel in the keys.

The 1080p Full HD display could be a touch brighter especially for outdoor use. Otherwise, the display is sharp, with vivid colours and saturation. It really shines when watching a movie or viewing photos, as well reading crisp text.

For those looking for a laptop around the $1,800 mark, where storage and screen size are the main priorities, the VivoBook S15 hits all the right notes. Between the hybrid SSD and HDD storage setup, the 7th-gen Core i7, and 8GB of RAM, its performance isn't an issue.

The biggest problem is its battery life, and even then it's not horrible. It would be nice if it came closer to a full day of use. In all, this laptop willl be worth more serious consideration when the price drops a little. ■

### Verdict

Features ★★★★½
Performance ★★★★
Value ★★★★

An affordable laptop that doesn't stand out from the crowd, yet still hits all the right notes.

★★★★½

apc RECOMMENDS

LAPTOP

$1,298 | WWW.ACER.COM

# Acer Swift 3

## Don't be deceived — this affordable ultraportable laptop is better than it looks.

**The Swift 3 is the latest affordable ultraportable laptop from Acer, whose most notable contributions to the PC space this year have included a US$9,000 (not officially available Down Under) gaming laptop and the world's thinnest ultrabook.**

For that reason, you may have expected the company to go big or go home with its next project. If the Swift 7 was Acer's flagship, the Swift 3 is, well, just a cheaper version of that. This laptop is intended for frugal shoppers. Making the best of a 14-inch, 1080p Full HD display, a 18mm thick frame and 1.6kg of muscle mass, there's no denying that the Swift 3 is fairly generic at first glance. But take a look inside and you'll discover a set of burly components that are equally at home within the all-aluminium chassis of the Swift 7.

Like most laptops, the Swift 3 comes in a number of different configurations, each with its own unique specs, from the entry-level Ultrabook with an Intel Core i3-7100U CPU, 4GB of RAM and a 128GB SSD, up to the top-end model, which takes advantage of an Intel Core i7 CPU, 8GB RAM and 512GB SSD. The model we were sent for review includes an Intel Core i5-7200U, 8GB of SDRAM and a 256GB SSD. There's no getting away from the 1080p screen, so if you're after a 4K display, look elsewhere.

To be frank, the Swift 3's looks are its weakest point. Although it can be had in a sleeker gold or black finish, or even a pink one, the unit we were sent for review appears to be the most drab of the bunch. Then again, what it lacks in coffee shop appeal, it more than makes up for in comfort and practicality. The first thing we noticed when propping it up alongside a MacBook was just how roomy the trackpad is. The keyboard feels way better than Apple's 12-inch clamshell of yesteryear, and is complemented by backlighting of which there are four levels. Beneath the directional keys is a pint-sized fingerprint reader, designed to be used with Windows Hello. Although it didn't work flawlessly on the first go, it's a worthwhile addition once you get used to how its rectangular shape doesn't quite match up with that of your digits.

One of the more commendable choices Acer has made is the inclusion of legacy ports, the most notable of which are two USB 3.0 connections and an SD card slot. You get a single USB 3.1 Type-C port, too.

Performance-wise, it isn't too far off the Surface Laptop or even the ASUS ZenBook UX310UA. Despite coming up short when it comes to screen resolution, its specs are eerily similar to both of these devices. In the DirectX 11 Sky Diver benchmark, the Swift 3 even achieved 1,870 points more than the ZenBook. It's also worth noting that the Acer attained nearly double the frame rate of the ZenBook in the Cinebench OpenGL test, claiming 42fps against the ZenBook's 21.69, making it the winner for light gaming and other media-focused tasks.

However, the speakers are on the bottom of the machine, making the audio extremely muffled. Still, at least there's a headphone jack and Bluetooth. In our PCMark 8 battery life test, the Swift 3 lasted 4 hours and 18 mins, besting the ZenBook by five minutes. That's not a huge difference, but it goes to show that you don't need to shell out for sufficient performance matched with an unwavering battery life. ■

### Verdict

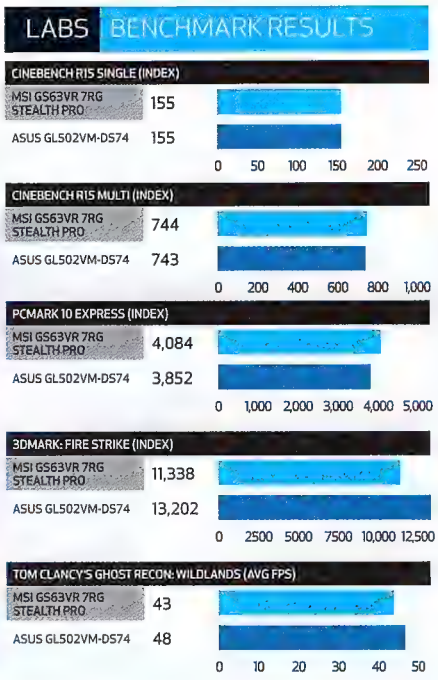
| | |
|---|---|
| Features | ★★★★ |
| Performance | ★★★★ |
| Value | ★★★★½ |

**Although it's a more affordable laptop, it packs the performance and battery life to compete outside its price range.**

★★★★½

GAMING LAPTOP

$3,399 | AU.MSI.COM


LABS BENCHMARK RESULTS
CINEBENCH R15 SINGLE (INDEX)
MSI GS63VR 7RG STEALTH PRO 155
ASUS GL502VM-DS74 155
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TOM CLANCY'S GHOST RECON: WILDLANDS (AVG FPS)
MSI GS63VR 7RG STEALTH PRO 43
ASUS GL502VM-DS74 48
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# MSI GS63VR 7RG Stealth Pro

## Performance to go.

**We've long been searching for a gaming laptop that offers solid 1080p performance in a frame that's not just portable, but is actually light and thin enough to toss in a regular backpack. The kind of machine that a college student could take to class, or a young professional into a meeting – and not have to worry about loud whirring fans. In short, a MacBook Pro that can play games.**

The MSI GS63VR comes pretty close to fulfilling that dream. With an Intel Core i7-7700HQ CPU, 16GB DDR4-2400 RAM and a 256GB SSD, the GS63VR is nearly identical to (if not a small step up from) the 15-inch Apple prodigy on productivity specs, while its GeForce GTX 1070 absolutely demolishes the Mac's Radeon Pro 555 GPU – all while costing a lot less.

Of course, Apple products have never been known for their frugality. It's the intangibles – design, build quality, and ease of use – that make its products appealing to pretty much everyone who doesn't want to play games. But with the GS63VR, we might have finally found a competitor.

The black aluminium chassis and screen hinges feel solid to the touch, with an elegant, understated design – by gaming laptop standards, at least. The SteelSeries keyboard offers full RGB backlighting, but more importantly, feels great to type on. Similarly, the touchpad is one of the best we've used on a Windows machine. And while MacBooks still reign supreme in the battery life category, we were able to get a modest 3 hours and 8 minutes out of the GS63VR – enough time for back-to-back meetings or a very lengthy movie.

The GS63VR does all this in a frame that weighs in at about 1.8kg, and measures only 1.7cm thick.

In our gaming tests, the GS63VR pulled in an average of 71fps across *Rise of the Tomb Raider*'s three-part benchmark, scoring 95fps in the Mountain Pass, 61 in Syria and 56 in the Geothermal Valley. *Total War: Warhammer II*'s Battle benchmark returned 55fps, while the demanding *Tom Clancy's Ghost Recon: Wildlands* came back at 43fps – all at 1080p using the highest available graphics preset. These results put the GS63VR and its Max-Q-tuned GTX 1070 on par with a 'regular' GTX 1060, as in ASUS's RoG Strix GL502VM or Acer's Predator Helios 300.

This is the one area where the GS63VR disappoints us. We knew there would be a performance trade-off that came along with the Max-Q design – after all, light and thin is essentially the antithesis to high-performance. The Max-Q GTX 1080 that we tested in ASUS's RoG Zephyrus didn't perfectly match a desktop-class GTX 1080, but it still outperformed the next card down: a desktop-class GTX 1070. By that logic, we knew a Max-Q GTX 1070 probably wouldn't keep pace with a desktop 1070, but we were hoping it would still be a moderate step up from the GTX 1060.

It seems that isn't the case – so, why should you pay more for a Max-Q GTX 1070 rather than a regular GTX 1060-powered laptop? Well, already talked about size and weight. The other key factor is noise. Every GTX 1060-powered laptop we've tested sounds like a jet taking off as soon as the fans spin up. Not here – the Stealth Pro lives up to its name. You won't hear this jet coming. ■ **Bo Moore**

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★½ |
| Value | ★★★★½ |

**It's light and thin, and super quiet. You pay more for these things over a regular GTX 1060 laptop, however.**

★★★★½

"Setup and configuration is done via an app that guides you through each step of the process and it's so straightforward that even less technical users will be able to get up and running."

MESH NETWORKING GEAR

**2-PACK, $649; 3-PACK, $749 | LINKSYS.COM/AU**

apc RECOMMENDS

# Linksys Velop

## A mesh networking kit that focuses on ease-of-setup.

**We've tested a batch of mesh networking kits in *APC* this year – a new take on how to solve the old problem of wireless dead spots. With its Velop range, Linksys has prioritised simplicity. Setup and configuration is done via an app for iOS or Android that guides you through each step of the process and it's so straightforward that even less technical users will be able to get up and running.**

Instead of being a package of a router and wireless extenders, each Velop unit is a router that can operate independently. These Velop 'nodes' are tall and white, favouring minimalism, with holes in the side to act as heat exhausts. The lean array of ports – just two Gigabit Ethernet ports per node, with no extras like USB ports – are hidden from view in the base of the unit, with a small gap in the side to feed cables through.

When you first turn on one of the nodes, the app uses Bluetooth to configure basic settings, creating and securing a wireless network before additional nodes connect to it.

Set up the next node and the app advises you on its positioning; press a button, give it a name and it's connected to your mesh network automatically. If a node goes offline, the app'll also tell you which one is down – and the rest of the network will stay up.

Other features, too, are easy to set up and manage. Parental controls are all managed from within the same app, without needing to log in to a web interface. However, delve a bit more under the hood and Velop doesn't offer the same vast feature set of other routers.

It only supports dual-stream 802.11ac to a max of 867Mbps per client device, for example, since the third stream is dynamically allocated to providing a connection to other Velop nodes. You can also forget about the kind of fine-configurability you find in DD-WRT, or things like VPN support.

In testing, the wireless performance was sufficient, but nothing special. We used a simple test from **speedtest.net** to get an idea of how well our 200Mbps broadband connection was being utilised, first at short range with just one node, then 15m further away, then again with a second node added to the mesh.

Speeds of over 117Mbit/s were achieved at close range, but this dropped off heavily when we moved the laptop further away, to just 7Mbit/s. With a second node switched on, at the same far distance, we got better speeds of 74 Mbit/s. That's roughly what you might expect from a high-quality wireless extender. In general, the fastest possible performance is not Velop's strong point.

But it's important to remember that Velop is not a networking product aimed at the type of user who wants to spend time configuring and controlling every last parameter in the product's software. Linksys already sells a number of other routers that allow for that, such as its advanced WRT series.

Instead, Velop is a product you could place in the hands of technically illiterate friends or family and be confident they can get it up and running without using you as free technical support. Few other products truly offer this, so Velop is exploiting a big gap in the market. But its simplicity carries a significant price tag – even compared to most of the other mesh wireless kits available.

**Orestis Bastounis**

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★½ |
| Value | ★★★½ |

Linksys has made Velop very easy to set up and the wireless performance is quite good. But it comes at a price.

★★★★½

PROJECTOR

$999 | WWW.BENQ.COM.AU

# BenQ GS1

## Not quite the streaming silver bullet for portable projectors.

**BenQ has taken the first step to making a portable projector that'll let you watch movies and TV shows without the need for an external player. Although this should theoretically give it access to dozens of existing streaming apps from the Google Play Store, the number of apps currently on offer is surprisingly limited. Instead of letting you access the Play Store and select the apps you want, the GS1 defaults to Kodi as its primary media playback software.**

The GS1 also includes a handful of other Android apps pre-installed, including a few of the OS's best file organisation apps alongside media players VLC and MX Player. For all those hoping to watch Netflix, the GS1 is at least compatible with the Wi-Fi Alliance's Miracast tech, as well as Apple's AirPlay. This might not be the direct streaming we're hoping for, but it will let you send streams from your Android or iOS phone to the device – and it's a feature set that's in-line with our favourite current mini-projector offerings.

It's slightly bigger than some competitors, but it's still perfectly portable and affords more space for the 30- to 100-inch short-throw projection display, which runs at 720p resolution. The picture quality is impressive, with a dynamic 100,000:1 contrast ratio, HDR colour gamut and 300-Lumen peak brightness, backed up by a 3-hour battery life, so you can even use it sans powerpoint. It's also more expensive than many competitors, but it definitely integrates enough of the right technologies to justify a higher price point.

■ Joel Burgess

### Verdict

It's a little pricier than we'd like, but this mini-projector packs a lot in to help justify the higher cost.

★★★★☆

MECHANICAL KEYBOARD

$180 | WWW.DASKEYBOARD.COM

# Das Keyboard Prime 13

## A mechanical keyboard that shows that 'basic' is sometimes better.

**We've reviewed a few of these pro-oriented, mechanical keyboards from Das Keyboard over the course of 2017, and the Prime 13 is definitely our favourite iteration. While the DK's 'boards are all quite similar, small differences can ultimately add up to quite different usage experiences.**

The 'Prime' in this board's name is meant to imply that it focuses on delivering good solid basics rather than fancy extras. It offers a great typing experience, with Cherry MX Brown mechanical switches for reliable performance and subtle resistance.

The most immediate difference between the Das Keyboard Prime 13 and the 4 Professional which we reviewed last month is that this more basic board has ditched both the bank of media controls (including that lovely volume dial) and the built-in two-port USB 3.0 hub – though you do still get USB passthrough, which requires plugging in a second USB cable.

Otherwise, it's all pretty similar when it comes to shape, size and weight. It does have one advantage over the Professional – its keys are backlit by white LEDs, meaning it's much easier to use in the dark.

We also prefer the Prime's braided USB cable and the fact that it uses standard fold-out feet to tilt the back of the board up (and at a nicely steep incline), rather than the weird 'plastic ruler' affair used with the 4 Professional.

The fact that the Prime 13 is a good $70 cheaper, dropping down from $250 to a more reasonable $180, doesn't hurt its appeal either...! ■ Dan Gardiner

### Verdict

While it's still not cheap, this cut-back mechanical 'board beats its more-expensive siblings.

★★★★★

apc HOT PRODUCT

TRACKBALL MOUSE

$119 | WWW.LOGITECH.COM/EN-AU

# Logitech MX Ergo

## Everything a trackball mouse needs to be.

**Is the MX Ergo worth switching away from the traditional mouse? Well, depending on what you're using your PC for, it just might be worth it. It's not hard to see why the trackball has remained a niche product – there's just something intimidating about using your thumb to push a ball around rather than moving the entire body of the mouse.**

That's without mentioning the number of buttons. More traditional mice have also suffered from button excesses, but by changing their placement, the MX Ergo forces you to re-learn how to use and locate them. The thumb buttons, for example, are to the left of your left-click button.

Obviously now that your thumb is dedicated to moving the trackball, it makes sense that the thumb buttons have to move, but their new position turns them into extra buttons for your index finger, and we think this removes a certain amount of their utility.

The MX Ergo also has a scroll wheel that can be pushed left and right for more functionality, and a small button to the left of the trackball that puts it in 'precision mode'. This slows its responsiveness so you can make smaller, more precise movements. It's useful for design work but you probably don't need it for everyday use. The same is true of many of the other buttons here.

Although the trackball is not textured, you should never have any trouble with it slipping, and it's just the right size to get maximum control without having to constantly readjust your thumb's position. If it gets a bit grubby, you can remove the trackball to clean it by taking off the magnetic plate on the bottom of the mouse and pushing the ball out with a pen.

This magnetic plate can also tilt the mouse up 20° for ergonomic reasons. When tilted up, your arm is in a complete resting position, and when you tilt the mouse back down, you'll notice the small bend your wrist has to make to use it.

You can choose to connect the MX Ergo to your PC either via the supplied Unifying Receiver (a USB dongle that plugs into your PC) or via Bluetooth. A small button below the scroll wheel enables you to switch between them. If you want to control multiple PCs at a time, then Logitech's Flow software is compatible with the MX Ergo. Flow enables you to control up to three PCs and gives you the ability to drag and drop files between them.

The mouse charges using a Micro USB port and has a claimed battery life of up to four months between recharges. Sadly, it's for right-handed users only.

If you're used to using a traditional mouse, then a trackball will feel incredibly weird at first. It's not just the movement of the thumb that feels different. You also have to let the trackball spin before stopping it to have the mouse travel large distances. It doesn't take long, though, before you get used to it – a day at most.

There are some who swear by gaming on a trackball, but spinning the ball to cover large distances never feels as accurate, and the added hassle of having to switch to precision mode to fine-tune your aim can slow you down a lot.

It's difficult to know what else a trackball could offer beyond what this model does. The Ergo might not have reinvented the wheel, but when it works this well, it's hard to ask for much more. And if you suffer from repetitive strain, it's well worth a look. ■

### Verdict

| | |
|---|---|
| Features | ★★★★ |
| Performance | ★★★★ |
| Value | ★★★★ |

Trackball mice aren't for everyone, but the MX Ergo does everything you need it to do, except cater to lefties.

★★★★½

**$2,499 | WWW.SAMSUNG.COM/AU**

# Samsung CHG90

## The monitor that throws a curveball at multi-screen gaming setups.

**We're not huge fans of curved TVs here at *APC* – we find that they generally sit too far away for the screen-curvature to have any practical value. However, because of their closer proximity, curved monitors actually make a bit more sense to us, with the potential to make it easier to see the extremities of a screen, particularly for ultrawide displays.**

Samsung's CHG90 has taken this symbiotic curved ultrawide monitor concept to the next level by making a 1.2-metre-wide, 49-inch curved gaming screen that's equivalent to two 27-inch 16:9 monitors sitting side by side. The key in this equation is an 1800R curvature (meaning the arc of a full circle would have a 1.8m radius) which, Samsung says, is designed to mimic the curvature of your eyeballs and create a more even distance between you and the entire screen. The result is an unprecedented amount of screen real estate that can be used as either a single continuous display (via the DisplayPort input) or as a dual screen by using multiple inputs – useful if, say, you want to game and still have other applications running simultaneously off to one side.

Samsung hasn't cut any corners when it comes to screen quality in order to make this head-turning size happen, with a 32:9 aspect ratio and a resolution of 3,840 x 1,080 pixels. Underpinning this is Samsung's QLED display technology which uses a quantum dot layer of nanocrystals to modulate LED backlighting into primary colours, reducing the light lost from RGB filtering.

This makes a significant difference in overall brightness and although the 600-nit peak brightness of the CHG90 doesn't reach the same 1,000+ nit levels you get from Samsung's best 4K TVs, it's more than you need for a screen that you sit within a metre of. Given its mammoth size, it's also surprisingly nimble, with a sub-1ms response time and a 144Hz refresh rate, meaning it'll keep up with the fastest graphics cards around, making on-screen motion as smooth and slippery as a greased piglet.

The screen offers the full NTSC colour gamut, which is almost identical to Adobe RGB and allows for greater dynamic range than the narrower sRGB gamut seen on most other gaming screens.

It's also got bells and whistles like inbuilt blue light dimming, a 20-step black equaliser to locally brighten dark areas in games, three custom preset buttons, four pre-calibrated game type optimisations, audio-synced backlighting and a handy directional toggle for the menu interface.

The only real misstep is Samsung's choice of anti-screen-tearing technology. There's only AMD Freesync support here, rather than Nvidia's G-Sync. Adding the latter requires the inclusion of a dedicated chip, so omitting it is a handy way of saving costs on budget screens.

With the CHG90's $2,500 price tag, however, it seems a little misguided for Samsung not to have gone with the green team.

If you can live with that shortcoming, though, this one's a monster of a gaming monitor that otherwise doesn't disappoint. Plus, it's one hell of a talking point.

**Joel Burgess**

### Verdict

| | |
|---|---|
| Features | ★★★★ |
| Performance | ★★★★ |
| Value | ★★★ |

While it doesn't have G-Sync, everything else about the monitor is perfect for gaming and productivity.

★★★★

GAMING KEYBOARD

$250 | WWW.ALIENWARE.COM.AU

# Alienware AW768 Pro Gaming Keyboard

## Stick to the earthly delights.

**Alienware's first foray into mechanical gaming keyboards has delivered an OK result, but the price doesn't stack up against its terrestrial competition. The company promises "otherworldly beauty" with this 'board, and while that's clearly a subjective claim, we'd argue that the angular wings on each side do little more than contribute to its overall bulkiness, which is at odds with the industry's trend of compact, minimal and portable.**

Moreover, while there's the requisite inclusion of RGB lighting alongside a rather dazzling underglow, it lacks per-key lighting customisability – which is standard well below the Pro's $250 price tag. Instead, there are lighting zones that you can tweak with effects or static colours, although there are certainly fewer than the promised 13, and the software used to assign them is simply baffling. There are five dedicated macro keys and a handy 'cycle' button, which selects one of three sets of macros. This is a clever approach, as it allows you to rapidly switch without having to leave your game.

Alienware only offers this 'board with one type of key switch, the Chinese-made 'Kaihua Kailh Brown', which offers nice resistance by straddling the clickiness of Blue-style switches and the linear actuation of Red-style. However, it's quite incongruous to see a $250 keyboard with only one switch option.

There is N-key rollover and anti-ghosting, but the fact that the magnetically-attached palm rest costs extra is just salt in the wound.

Harry Domanski

### Verdict

A passable keyboard at a ludicrous price makes for a tough recommend. Look elsewhere.

★★½☆☆



GAMING MOUSE

$179 | WWW.ALIENWARE.COM.AU

# Alienware AW958 Elite Gaming Mouse

## An out-of-this-world price.

**Although the Elite Gaming Mouse offers some neat tricks for gamers, its price is something of a deal-breaker. Still, the combination of metal- and rubber-coated plastic surfaces make the device look and feel quite striking and, for the most-part, the construction seems to reflect this quality, although the scroll wheel is a little on the wobbly side.**

There are several physical configurations on offer, with two interchangeable side-grips for each side offering different grip and button layouts (with either two or six side buttons), a three-position palm grip and a clever configurable weight system that can add up to 20g of heft. Its lack of ambidextrous support to complement its near-symmetrical design, however, is its biggest missed opportunity.

The main left and right clickers (which use Omron switches) feel satisfying, and their cantilever design means that they require less pressure to depress the closer you are to the edge of the button, for simple sensitivity adjustment. Another clever feature is having a rocker rather than a cycling button, which bumps the DPI up or down through each of the configurable settings. You can also assign macros to the side buttons and adjust the limited lighting zone.

However, just like the company's new Pro gaming keyboard (opposite), the competition tends to be superior in both features and affordability. Have a look at the Roccat Nyth and Razer Naga for customisable, button-heavy mice, or the ASUS RoG Pugio for an ambidextrous option.

Harry Domanski

### Verdict

This premium mouse mostly hits the mark, but its aim is thrown by an exorbitant price.

★★★★½☆

GAMING MOUSE

$79 | WWW.ASUS.COM/AU

# ASUS RoG Strix Evolve

## A little southpaw spice.

**The ASUS RoG Strix Evolve Aura RGB USB Wired Optical Ergonomic Ambidextrous Gaming Mouse (7,200dpi) – which sounds more like keyword targeting than product naming – is the first ambidextrous mouse we've seen that has gone beyond a simple symmetrical design and truly innovated.**

Included in the box are four interchangeable top plates – a high and low profile for the left and the same for the right – which, when attached in different configurations, offer four distinct feels; left-handed, right-handed or high and low neutral (or flat). Sound weird? It's actually a really clever design. This reviewer likes a little ergonomics, so clipping a high plate on the left and a low on the right results in a nice tapered feel in the right hand. But if you're a heathen who prefers symmetry, using a high profile on both sides gives a more DeathAdder-like feel. At 12.5 x 6.5 x 4.1cm, the Evolve feels long and narrow in the hand which is fine for this ape-pawed full-fister, but might be offputting for fingertip gamers though the kung-fu grip on the sides helps maintain control. Looking deeper, the Evolve boasts durable Omron switches good for 50 million clicks and an optical sensor with 7,200dpi, 30g acceleration and 1,000hx polling.

The split chasis features a neat lighting system with the middle and tail illuminating in more colour options than anyone really needs, which, of course, can be tailored to match your keyboard, headset and PC LEDs through ASUS's downloadable software. And best of all, it's cheap!

Troy Coleman

### Verdict

A beautiful solution to the ambiedextrous puzzle and a great gaming mouse to boot.

★★★★★

GAMING MOUSE

$110 | WWW.RAZERZONE.COM

# Razer Basilisk

## An FPS gaming mouse that'll have you clutching for headshots.

**Judging by the name, Razer really thinks its new 'FPS mouse' is the shizzle. European folklore holds that the basilisk – a mythological chimera-like creature – is the 'king of the serpents', able to kill enemies with just a glance. There's just one problem with that 'kingly' identification: Razer arguably already has a top-dog gaming mouse in the form of the DeathAdder.**

Razer claims that this is perfect for first-person shooters, largely thanks to a new thumb button called the 'DPI clutch'. Hold it down and it'll temporarily adjust your DPI sensitivity to whatever pre-determined setting you've configured. The theory is that you can use a higher sensitivity most of the time, but temporarily drop it down if you need fine-control over smaller movements – when you're peering through the lens of a sniper scope, for example. And, somewhat surprisingly, that little button certainly seems to make it feel easier to quickly zero-in.

The Basilisk's design is a little unconventional for a Razer mouse, using a more aerodynamic body profile than we're used to, which incorporates a tapered front and back and a slightly taller rear – making this well-suited to palm-grip gamers. Large ridged-rubber sections on each side also help keep the Basilisk firmly in your hand.

In short, while we're not quite willing to crown it as the definitive DeathAdder killer, if you play a lot of FPSes and want to pull off more headshots, this mouse may give you a slight edge – and we're looking forward to seeing that DPI clutch used in other designs.

Dan Gardiner

### Verdict

Razer's new DPI clutch button might just be the best addition to gaming mice in years.

★★★★★

GAMING HEADSET

$199 | WWW.RAZERZONE.COM

# Razer Tiamat 2.2 V2

## Are four drivers better than two?

**As with its stablemates in the current Razer lineup, every effort is made to make this headset feel luxurious. An aluminium headband over a memory foam contact pad gives the cans a comfortable fit. A reasonably light 414g weight makes it comfortable to wear for long periods, although synthetic leather and closed cups being what they are, it does get hot around the ears after a while.**

The headline act on the spec sheet, however, is the introduction of two 50mm drivers inside each earcup. At the base of the right cup is a toggle switch, which gives you the power to activate all four drivers, or go with the standard two. The effect of having all four activated is a well-balanced and warm overall tone. Bass-heavy, yes, but not to the extent that it muddies the mid-range frequencies. While it might seem a little gimmicky, it's actually a great call to put this choice in your hands. The two drivers mode is a flatter and clearer sound and lacks a bit of mid and high clarity.

The mic, a malleable hinge arm, is good quality, too.

There's a big 'but', sadly. The 1.3m 'braided' cable is noticeably thin and fragile-looking. The same's true of its additional splitter cable, and right out of the box we had connection problems with the audio jack. In fact, it took significant cable-wiggling to even produce a sound. It's a shame to see this otherwise competitive headset hobbled by a flimsy cable, because the addition of four drivers – and, importantly, user control over them – is really enticing.

■ Phil Iwaniuk

### Verdict

Choose two or four drivers with your super-comfortable cans, but watch out for that flimsy cable.

★★★½☆

WEBCAM

$300 | WWW.LOGITECH.COM/EN-AU

# Logitech Brio 4K Stream Edition

## Too much webcam, or just enough?

**Logitech's engineers (who have, it must be said, been on fire recently) realised that they could create a 4K webcam without stopping to think if they should. Then its marketers slapped the word 'stream' on it, despite the fact that rendering and uploading a stable 4K stream is beyond most PCs, internet connections and streaming hosts. And then its power-crazed number-crunchers decided $300 was a perfectly reasonable price.**

This is that dream device: a higher resolution sensor, HDR support, wider angles, up to 90fps capture, and support for Windows Hello on board. The stand includes additional points of articulation, and a standard camera-mount thread, so the Brio can be attached to a tripod. The fact that its sensor can pull a respectable 4K image at 30fps shouldn't be its major sell, though. It can certainly do that, although the results at full stretch are rather noisy and grainy. This is a webcam, as opposed to a broadcast-ready 4K camera. When you drop it down to more realistic resolutions, the power behind the sensor really shows; at 1080p 60fps, it's crisp and smooth, and at 720p 90fps, it's a perfectly acceptable streaming resolution. HDR support makes a massive difference to the colour depth.

Below 4K, you can adjust the viewing angle, or use the much-improved driver within the Logitech Gaming Software app to virtually pan and tilt its viewport. You're also given a high level of control over brightness, saturation, white balance, and more.

The Brio is, however, far too expensive. ■ Alex Cox

### Verdict

Fantastic picture from 1080p down, plenty of tweakables, Hello-able, but with a painful price tag.

★★★★☆

GAMING MOUSE & KEYBOARD COMBO

$99 | COOLERMASTER.COM

# Cooler Master Masterset MS121

## A surprisingly decent starter kit for the PC gamer on a budget.

**For fresh-faced PC gamers chasing a highly coveted mechanical-switch keyboard – but who're also, perhaps, a little strapped for cash – this keyboard-and-mouse pack offers a worthy compromise.**

Both components of the Cooler Master Masterset have an unassuming aesthetic, although the clearly visible white plastic layer beneath the keys does taint this effect somewhat. The same layer is also responsible for extending the otherwise-dazzling RGB lighting a little too far from the keys. The mouse and keyboard are both built from plastic and are about as ergonomically vanilla as possible. While the keys feel fairly sturdy, the mouse is a little light and plasticky.

Cooler Master is calling the switches on this 'board 'mem-chanical', but they don't feel as awkward as that title sounds. This tech utilises a membrane layer with rubber domes to register the key's actuation, but the switch itself has a faux-mechanical operation, so the user feels tactile feedback on each press. The intention of this technology is to offer up the mechanical feel at a membrane price and, at $99 for the set, it's certainly affordable. The switches feel convincingly mechanical for the most part, but the acoustic feedback is annoyingly high-pitched and loud. You can replace the keycaps with any other Cherry-compatible offering, which is certainly a nice touch, and while 26-key anti-ghosting and a 125Hz polling rate aren't top-of-the-line gaming specs, they make for a keyboard more than capable enough for the vast majority of gamers.

As is the case with some of Cooler Master's more premium keyboards, there's no software support here. While this makes for plug-and-play simplicity, the loss of fine control over key assignment and RGB customisation is a tad crippling. Instead, you need to rely on a rather complex system of keyboard shortcuts to muck around with, and if you're a fan of assigning keyboard shortcuts and macros, you'll have to look to third party software solutions.

The mouse suffers similarly from its lack of software. You can set the two lighting 'zones' to one of eight colours (not independently) and cycle through a small number of effects with some button combos; but the real sacrifice is the inability to assign the six buttons to anything but their original function.

Despite the shortcomings, there's little to complain about with the included mouse, and considering it comes with durable Omron switches and a dedicated button to switch between four DPI settings; you can certainly end up with worse clickers for the price.

The value of this set relies heavily on whether or not you're after an included mouse, in which case the compromises are well worth it, or if per-key RGB (albeit, without fine control) is more important than true-mechanical switches. If you're not in need of either, there are some similarly priced and fully mechanical alternatives.

Harry Domanski

### Verdict

Features ★★★½☆
Performance ★★★½☆
Value ★★★★½

**While this set is a great option for budding gamers, there are some caveats and limitations with customisation.**

★★★★☆

# software

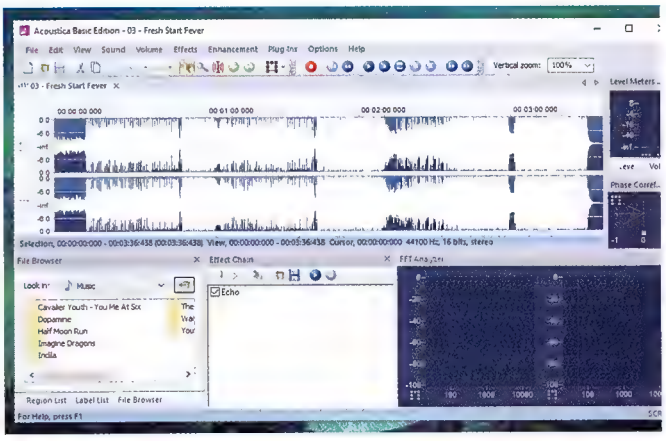
» APPS FOR ALL THE PLATFORMS

## Windows SOFTWARE

# Acoustica 6 Basic Edition

### Back to basics.

**FREE | ACONDIGITAL.COM/DOWNLOADS**



**As the free version of a premium audio editor, it's not surprising that Acoustica Basic Edition is a much more stylish affair than its open-source and donation-supported counterparts. Unfortunately, developer Acon Digital hasn't released a free version of its latest release, Acoustica 7, so you'll need to look under the 'Old versions and discontinued products' section of its downloads page to find this Acoustica 6 Basic Edition.**

While you'll miss out on options such as a multi-track editor, support for 7.1 surround sound and advanced tools for cleaning up old vinyl or tape recordings, you still ultimately get a lot to play with.

Acoustica sits comfortably between more technical audio editors like Ocenaudio and Audacity and simple tools like MP3 Cutter and Editor. It won't be sufficient if you're a professional musician, or want to create flawless audiobooks, but for making simple recordings, importing and editing tracks from CDs and combining multiple files, it's superb. Best of all, all edits are non-destructive, so you can revert back to your original file at any time, and the undo and redo functions are unlimited.

Acoustica looks great and is easy to navigate and customise thanks to a panel-based approach, which lets you position its tools where you want. You can also scrub through audio until you find the section you want — a feature missing from many free audio editors — and files can be exported in a variety of compressed and uncompressed formats.

Another of the biggest advantages this Basic Edition has over other free audio editors is its Effect Chain, which enables you to layer effects on top of one another, then add or remove them later. These include volume changes, fades and other effects like echo and reverb. There aren't very many of these provided as standard (and far fewer than in Audacity) but you can download more as DirectX and VST plugins.

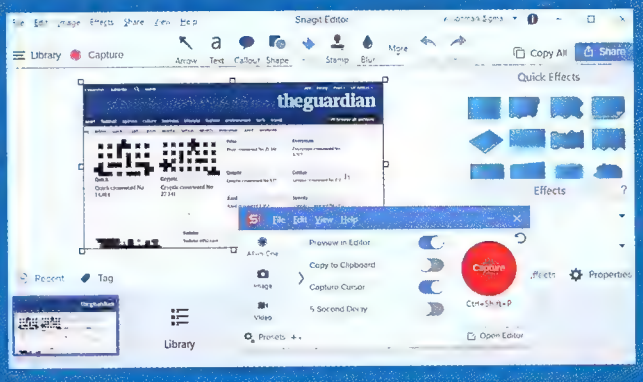
Even if you've never used an audio editor before, Acoustica 6 Basic Edition won't leave you feeling overwhelmed. It's a little limited at first, but you can easily expand it and make it much more powerful as your requirements grow.

**Cat Ellis**

## Snagit 2018

### This is not an information technology sausage.

**US$49.95 | WWW.TECHSMITH.COM**



Taking a screengrab in Windows isn't particularly difficult. It's just a matter of hitting the Print Screen key or using the built-in Windows 10 Snipping Tool — so why would you want to spend money on software for taking screenshots? Snagit 2018 is an answer, but is it 'the answer'?

Sure, Snagit will grab everything on your screen including individual windows and videos of on-screen activity if you want, but it also does much more, like scrolling screenshots of web pages and pulling out text from screenshots using OCR.

Snagit has other advanced features that further justify the high price tag, letting you use a custom keyboard shortcut to grab everything you can currently see, or even set a delay timer so you can prepare your shots before capturing them.The image and video capturing side of Snagit is comprehensive, but there are robust editing tools that allow you to annotate, add shapes and insert objects, too. Combine these features and it's clear that Snagit is a professional tool that's exceptional at what it does, but you'd have to really need to do a lot of screen grabbing to fork out the US$50 asking price.

**Mark Wycislik-Wilson**

# Corel Painter 2018

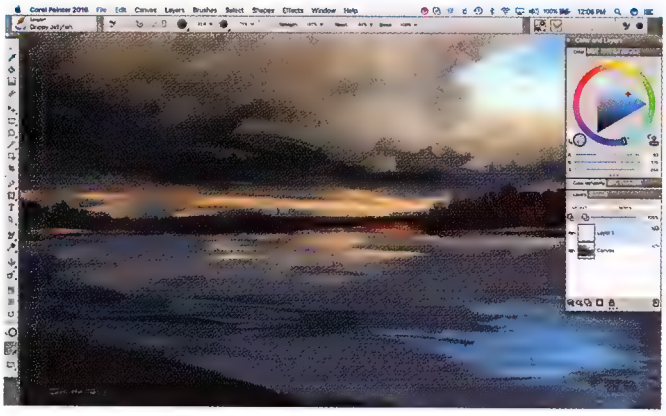
## The art app that just keeps getting better.

**$429 (CURRENTLY ON SALE FOR $385) | PAINTERARTIST.COM**

**This release of Painter has many new features that will make the digital artist in you quiver in anticipation. The Thick Paint option is a set of painting tools beyond the Impasto ones that were present in earlier versions, accurately mimicking the look and feel of traditional oil and acrylic paint. You can pile on the paint, push it around, scrape the paint, and realistically blend it.**

Elsewhere, you can now paint using Texture Cover, Texture Source Blending or the new 2.5D Texture Brushes, which enable you to change, scale or transform the texture at any time. Another new feature, Texture Synthesis, lets you to pick an area of a document or texture and reproduce it at a larger scale. When synthesising a new texture, the selected area of the original one is randomised across the new document, creating something unique. You're not limited to using textures either: the brushstrokes in a document enable you to create a new texture. The resulting image can be used as any other texture, or as a layer in your painting.

There are a number of smaller yet welcome new features, too. The Enhanced Drip and Liquid brushes work on an empty layer to blend a colour with an oil paint-like transparency, or to paint using colours from underlying layers. Random Grain Rotation will rotate the active paper texture with each brush stroke, giving a natural look. There's also a redesigned Natural Brush library, and you



can create your own selection brushes using any dab-based brush variant. Finally, new cloning capabilities give you the ability to adjust the size and shape of clone sources.

There have also been a number of background and interface tweaks, making the software easier to use. Overall, Corel has done well in updating Painter so that, more than ever, it brings the worlds of traditional and digital art closer together. Painter 2018 sports great new additions to refine your digital painting experience.

**Don Seegmiller**

## Transmit 5

Our Mac file-transfer favourite gets in sync with the modern web.

**US$45 | PANIC.COM**

Transmit 5 has been a long time coming, and web services have moved on a lot since its predecessor arrived — although the need for a robust, usable file-transfer tool remains. Fortunately, this release greatly widens the app's support for cloud storage solutions. It still works with SFTP, Amazon S3 and WebDAV, and adds support for Backblaze B2, Google Drive, Dropbox, Rackspace Cloud Files and more. You might question the inclusion of Dropbox and its ilk, but their native apps typically require you to sync everything you store there to your Mac. With Transmit, you can grab only you need.

The app's interface has been spruced up with Panic's chunky Mac toolbar tabs, and a visual aesthetic echoing Transmit's iOS incarnation. There are practical tweaks, too: a Places bar for stashing per-server folder shortcuts; an Inspector sidebar to delve into an item's details; and an Activity window, for peeking at current and recent activity.

The flip side is a peppering of quirks that may grate: the reduced toolbar drag area when you have several tabs open; the Inspector's inability to automatically preview a selected image (you must use macOS's Quick Look feature); and the Activity window omitting a full list of pending uploads.

On balance, though, Transmit 5 is a noticeable improvement. It's faster — fling loads of files at an SFTP server, say, and it blazes through them compared to version 4. And there's a sense of Panic sweating the details to boost productivity. Real-time sync capabilities include a simulation option, so you can check your settings won't cause chaos. There's batch renaming, copy and paste for files, and options to define custom cloud server headers. Also, Panic Sync has arrived on the Mac, so you can share server details with Coda, and Panic's iOS apps.

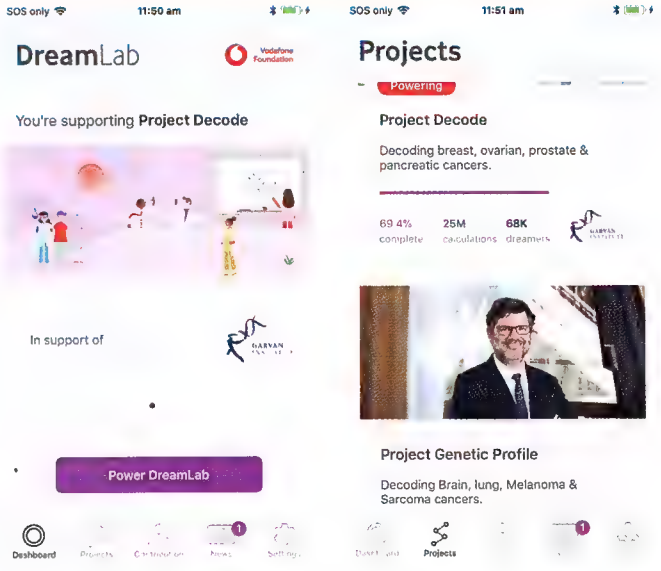
There's no getting away from the fact some of this stuff is Transmit playing catch-up, Panic wrenching its app into the present; Panic Sync's omission from the Mac version of Transmit has been notably perverse. But minor grumbles aside, there's no doubting this latest release again propels Transmit to the head of the file-transfer app pack — on any platform.

A solid update to a dependable app, with a smattering of great new features. **Craig Grannell**

# DreamLab

## Find a cure in your sleep.

**FREE | WWW.GARVAN.ORG.AU/GET-INVOLVED/DREAMLAB**




**We first reviewed DreamLab back in issue 59. The app was only available on Android, but has since made its way to iOS, and remains largely the same. Designed to be used while you're asleep (or while your phone's recharging), the app harness the processing power of your phone to crunch complex equations in the cure for cancer.**

Two broad research streams are yours to choose from: Project Decode, which aims to decode the genetic makeup breast, ovarian, prostate and pancreatic cancers, and Project Genetic Profile, which looks at the genetics of brain, lung, melanoma and sarcoma cancers. Pick your project, plug in your phone, and the app connects to the Garvin Institute, a group that researches a variety of diseases.

You have a choice of how much data you want to donate to the cause per month on both mobile (up to 500MB) and Wi-Fi (from 250MB to unlimited). There's no limit to how much or little you turn the app on, and a timed 30-minute test solved four problems. This really is best used when your phone is idle, as you can't quit the app or (ironically) put your phone to sleep. Leave the screen dimmed, turn off the light, and sleep well knowing you're working towards a cure for a disease that affects one in two Australians.

**Paul Taylor**

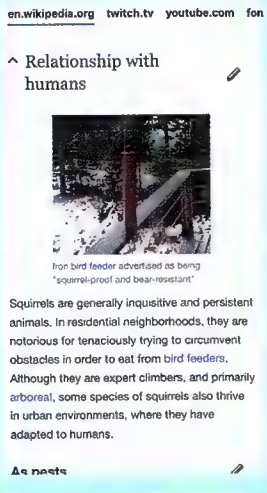
## Cake

### Taking a slice out of Google.

**FREE | CAKEBROWSER.COM**

Search engines on mobile are broken, according to the Cake development team. Their main problem is that they're simply not fast enough, or geared towards giving you results expediently. Rather than presenting a dull list that relies purely on text, Cake preloads the top results and lets you scroll through them, the page loaded and ready to go. You can pre-filter the results based on video, images, a simple web search, news or ecommerce if you want to buy the thing you're looking for. It's an appealing concept — searches done quickly — and the interface is lovely, clean and simple. Having the subsequent results at the top of the page, ready to scroll through, is a nice touch. However, Cake's concept does raise a few questions, like how it searches and organises the results, and it's completely reductive, taking the idea that a search term needs to be on the first page of Google, and 'above the fold', to 'this is what you get'. Choice can be overwhelming, sure, but a narrower focus seems a bit dangerous. An Android version is coming soon.

**Paul Taylor**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Relationship with humans
Iron bird feeder advertised as being "squirrel-proof and bear-resistant"
Squirrels are generally inquisitive and persistent animals. In residential neighborhoods, they are notorious for tenaciously trying to circumvent obstacles in order to eat from bird feeders. Although they are expert climbers, and primarily arboreal, some species of squirrels also thrive in urban environments, where they have adapted to humans.

## Satellite Tracker

### Gaze at the stars through your phone.

**FREE WITH IAP | VITOTECHNOLOGY.COM**

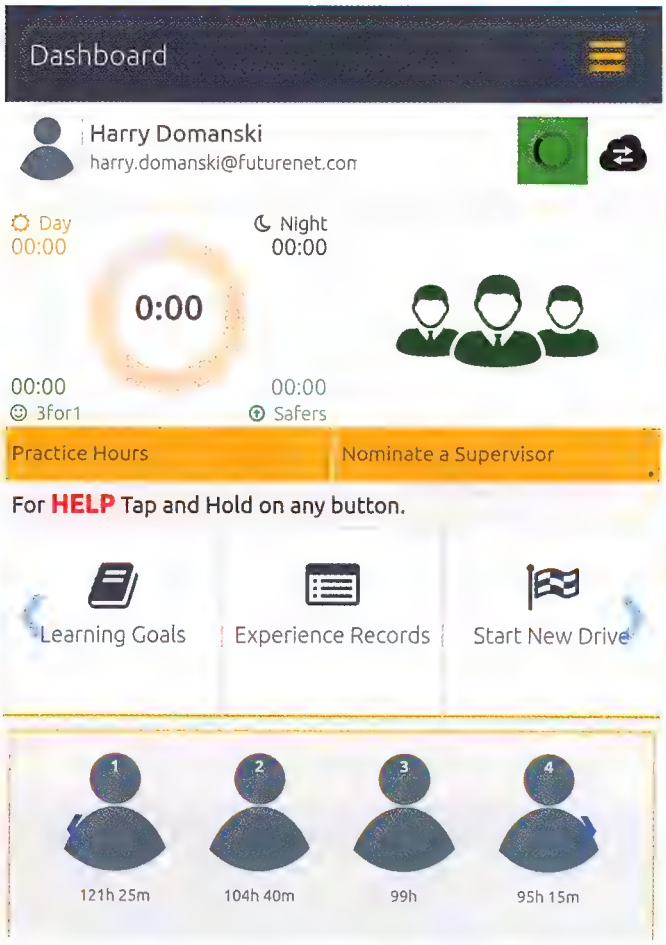
Space lovers may be familiar with a little app named Star Walk that received the Apple Design Award back in 2010. Well, the same developer has been hard at work here, so we were excited to see whether the same quality of product was on offer.

If you're interested in the flight patterns of the numerous satellites in orbit, this app might sate your appetite. There are 15 to select, including the ISS, Hubble, ADEOS II and the Genesis satellites. Pick one and you can rotate a 3D model of the craft, and see where it is around the planet in real-time. The app also tells you what time of day the satellite is likely to pass over you next, if at all, and other information about the craft, such as, in the case of the ISS, who is currently living on it and from which country.

It also includes a star map, which had your humble reviewer swivelling around on her wheelie chair like a child. Hold up your phone and you'll be able to see the positions of stars and satellites. (Jupiter, Mars, Venus and Mercury are all in a line at the moment. That probably means something bad for all you Virgos out there...)

However, we have to note that most of this app is hidden behind a paywall. If you want to investigate beyond the free version (which offers just the ISS and nothing more), then you will be asked to pay a $1.49 subscription fee every three months to access 'Satellites Live', which sounds like what Satellite Tracker was supposed to be — namely, "instant access to tracking satellites live orbiting over the Earth and in the sky". Without that subscription, this is just the ISS Tracker app, which is more than a little disappointing. **Carmel Sealey**

# Google Play » ANDROID




# Licence Ready

## A digital and automatic NSW Learner's logbook with some lessons of its own.

**FREE WITH SUBSCRIPTION | WWW.LICENCEREADY.COM.AU**

**Licence Ready could make those 120 hours of learning to drive a car a little less painful for NSW residents, thanks to an array of nifty logbook-related tricks and digital lessons.**

This app aims to be an all-in-one solution for NSW drivers on their Learner licence, bringing together automatic logbook entries, lessons and planning. On top of that, the app gamifies the whole endeavour by anonymously comparing your progress against others using the app. By keeping track of your driving via location services, the app will log your data automatically in its digital logbook (which is officially accepted by the NSW Roads and Maritime Services), as well as offering suggestions on what to focus on next. The app can be useful for supervisor, too, with lesson planning and other analysis options that help interpret the driver's progress. However, most of these more-advanced tools are only available with Licence Ready Pro, which will set you back $55 for 24 months access... **Harry Domanski**

# Microsoft Launcher

## Bring your Windows desktop's ecosystem with you in your pocket.

**FREE | ARROWLAUNCHER.COM**

If you're a big Microsoft fan and are mourning the demise of the Windows Phone platform, this 'new' Android app may just be your best friend. Although it doesn't boast the same tile-heavy interface, Microsoft Launcher (formerly known as Arrow Launcher; hence the web address above) paves its own path and offers some excellent integration and familiar features for Microsoft app and service users.

Aesthetically, there are options to have the same transparent theme as introduced in the Windows 10 Fall Creators Update on other devices, and you can change between accent colours.

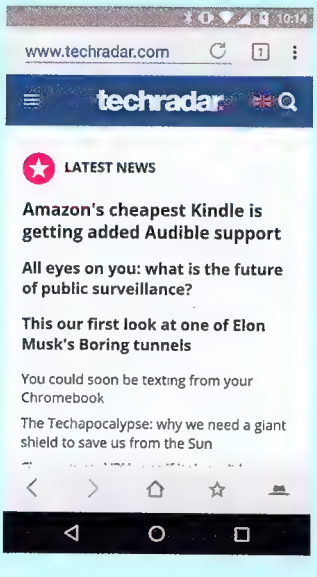
This launcher offers the ability to 'Continue on PC' for projects in the Microsoft Office suite (Word, Excel and so on) so you can keep working on your file once you get home, and the same can be done for websites you're browsing. This, along with the launcher's integration with your calendar and to-do list, are the most compelling reasons to switch to this launcher and will be a treat for Microsoft users wanting to carry their familiar desktop environment with them. **Harry Domanski**

# MINT Browser

## A stripped-back, privacy-centric browser alternative.

**FREE | MINTBROWSER.COM**

MINT is a stripped-back web browser which foregrounds privacy. Not only that, but it also supports proxying through Tor — the encrypted, anti-surveillance desktop browser — which goes to show how serious it is. While the privacy-related features are something you'll need to take a leap of faith on, other more UI-centric features make it a decent enough browser to use even if you're not a stickler for privacy. There's bookmarking, history and notes, as well as Fingerprint Scanning to access the browser's special Incognito+ mode, which can also be accessed via a password of your choice. The whole shebang is $1.99, though you'll get a good enough feel for whether you want to use the browser via the free version. If you're not worried about internet privacy now — you're not a criminal, right? — you'll probably worry about it in a few years time, so have a look at this. **Shaun Prescott**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# Borg

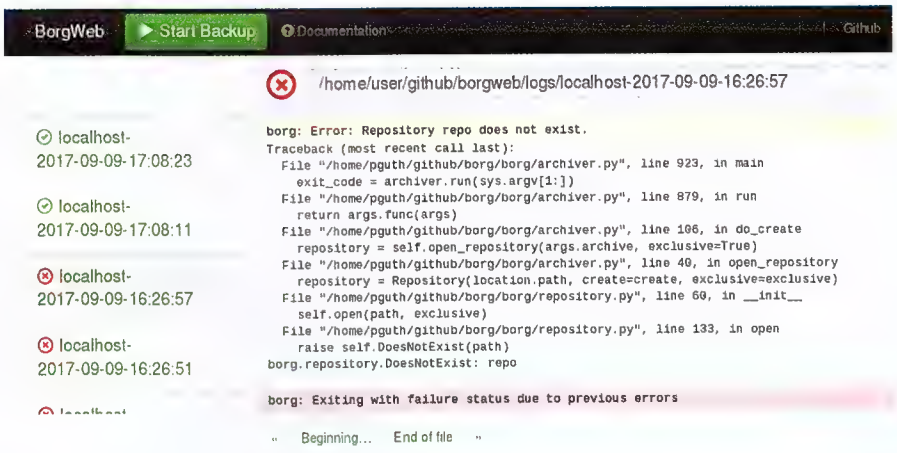
## De-stress with this back-up system.

**FREE | BIT.LY/BORG-B**

**There are a number of Linux solutions for data backup available. Perhaps they should be compared with the endless number of text editors, web browsers or music players out there. Yet data backup is an important computing strategy that eclipses the real-world cost of any software of hardware, so we shouldn't dismiss such programs so easily.**

This time, we're looking at Borg, a universal back-up solution for either enterprise or home use. It's a command line Python-based application with some decent features, such as the ability to create space-efficient storage of backups and authenticated encryption. You can run incremental backups of your data, compress it with LZ4, zlib or LZMA, secure it with your password and then manage it remotely.

That last statement needs clarifying. You can mount your backups as FUSE volumes and access them with your favourite file manager. We don't want to promote one back-up tool over the other, so don't go ditching your rsync-based back-up solution in favour of Borg, but we have to say the latter is very good at chewing through large and constantly changing arrays of data.




Borg applies deduplication for reducing the size of your back-up file (combine it with the LZMA compression to further slim down the back-up copy) and it performs this task well. The utility uses Cython (C extensions for Python) under the hood and it's been optimised to quickly handle sync caches. It's got a small memory footprint, too.

If you're eager to try it out, don't miss the web-based GUI, developed alongside the main Borg code. Borgweb is a web server that's supposed to run on the same machine that's being backed up by Borg. The appealing interface features a big green StartBackup button and an easy-to-read log view. Search your Linux distro package manager for something like 'borgbackup' and don't forget to set up Borgweb for easy back-up file review and archive control. **Alexander Tolstoy**

## Gnome Commander

File manager, sir!

**FREE | GCMD.GITHUB.IO**

Robots steal our jobs, corporations invest in the emerging cryptocurrencies market, scientists are making plans for Mars colonisation... and yet millions of people still prefer classic twin-panel file managers to anything else. The success of Total Commander in Windows is undisputed, but in Linux, we have more than one twin-panel manager, and that gives us a great choice. We've previously written about Krusader and Double Commander, but have somehow overlooked Gnome Commander, a great application that resembles Total Commander in many ways. Time to remedy the situation...

Gnome Commander follows the well-established convention for key bindings and shortcuts and enables you to use familiar keys for manipulating files (F5 to copy, F8 to remove and so on), just like Norton Commander. The application still relies on the GTK2 library, which also means that the GUI layout is quite compact, and virtually no screen space is wasted (contrast this to GTK3's expansive controls). There are a number of supported features, which is great considering how simple and easy to use the program is.

Gnome Commander works perfectly as an administrative utility for managing remote files. You can establish and save FTP, SSH, WebDav and even Samba connections, and access remote files with ease. The program comes with sensible default options for integrating with other desktop accessories.

When you double-click a file, it'll be opened with the associated application, but if your default archive manager is File Roller, then you can benefit from the File Roller plugin in Gnome Commander and use name patterns when creating new archives. The file manager supports tabs, bookmarks, file filtering and offers a vast set of objects for you to configure according to your personal preferences.

The new release had been in development for nearly a year, so it's definitely good news to see this smart app going strong and being well-supported. **Alexander Tolstoy**

# INTEL LEVELS UP: Everything you need to know about 8th-gen Core i

Give it up for Intel's 8th-gen Core processors, urges Jeremy Laird.

**Intel's 8th Generation core processors have landed. They're the most exciting mainstream CPUs from Chipzilla in at least five years – but also the most confusing. In fact, Intel's 8th-generation Core isn't really a generation of CPUs at all. It's more a collection of products with common branding than a distinct 'generation' of processors with something approaching a homogeneous feature set.**

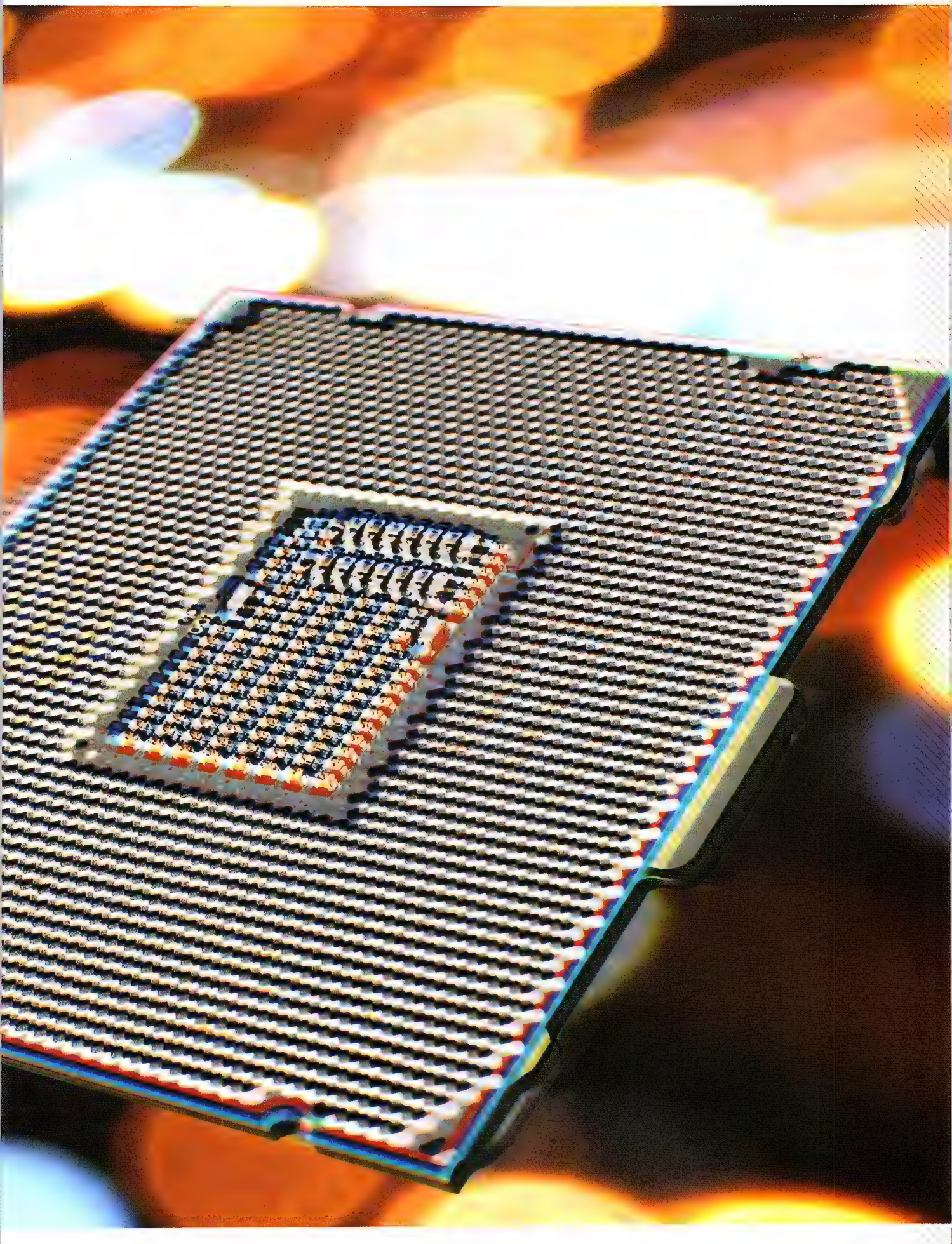
Eventually, 8th-gen Core will contain CPUs from three generations of processor design, and be manufactured on two silicon production nodes. But even with three generations and two production nodes, 8th-gen Core chips don't include Intel's new multi-core chips that range from 10 to 18 cores. Those fall under the 7th-gen banner. Intel never makes it easy to understand its product range...

If Intel's marketing can be utterly baffling at the best of times, 8th-gen Core remains really good news for the most part. For starters, we're looking at the first major step forward in mainstream desktop CPU performance from Intel for a very long time. In simple terms, you're getting more cores at every mainstream price point. Hurrah! Mobile performance and battery life are on the up, too.

Where the confusion comes in is that, unlike previous generations, where being a part of a specific generation of Core processor meant something in terms of features and capabilities, the simple fact of a CPU being 8th-gen doesn't tell you much. Instead, you're going to have to stay on your toes to keep up with the pros and cons of Intel's new range.

With that in mind, we've drawn together everything you need to know about these new CPUs. From the absolute entry-level chips to mobile masterpieces and desktop killers that set new performance standards at certain price points, we've got the full low-down. So now you'll know what to expect, where the best bang-for-buck is to be found, and which chips fit best with your PC usage.

Let it rip!



Chronologically speaking, Intel's 8th-generation CPUs began where it so often does these days: with a mobile CPU announcement. But right off the bat, something wasn't quite right. A quartet of new 'U' Series mobile processors debuted the 8th-generation nomenclature, including 8000 Series branding. But they were based on neither a new silicon production node nor a new processor architecture. Seriously?

That's worth repeating. Intel is calling the chips 8th-generation, but they are manufactured on 14nm production tech, which dates back to the Broadwell generation in 2014. Since then, Intel has revised its 14nm offerings with the Sky Lake and Kaby Lake architectures. So this would be the fourth new CPU family on the 14nm node, although Intel characterises it as a revved-up '14nm+' process, with improved transistor fins, increased channel strain, and other tweaks that add up to a claimed 12% performance increase from process improvements alone.

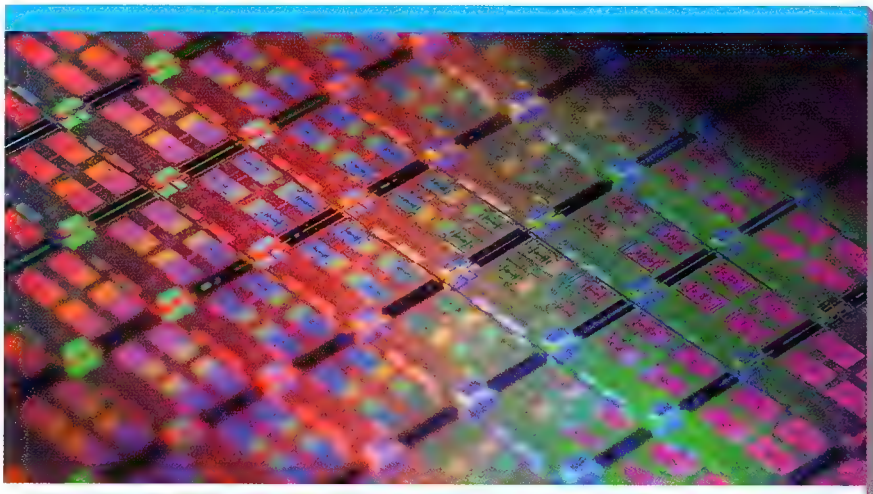
That's unprecedented for Intel. Not long ago, Intel used to design CPUs to conform to its so-called Tick-Tock cadence of chip creation, in which the aim was to crank out a new architecture, then shrink it to a smaller production node in successive years. But in early 2016, Intel announced it was ditching Tick-Tock in favour of 'Process, Architecture, Optimization'. In other words, in year one, Intel would shrink an existing CPU to a smaller silicon production node. In year two, it would release a new architecture on that new node. And in year three, it would revise and optimise that new architecture.

The move was an implied admission that Moore's Law is toast. Along with the rest of the integrated circuit industry, Intel is increasingly bumping up against the laws of physics. Shrinking its transistors every other year is no longer a goer. But that much we already knew before 8th-gen Core arrived. The surprising thing about those first mobile processors is that they don't even conform to Intel's new 'Process, Architecture, Optimization' cadence. In fact, they're a mildly tweaked revision of the existing 14nm Kaby Lake architecture.

Arguably, of course, that's just details. What really matters is that with the new 8th-gen U Series mobile CPUs, Intel replaced a quartet of dual-core models with quad-core CPUs, and is doing so at slightly lower price points. The one downside involves clock speeds. Peak Turbo frequencies have been maintained or even improved, but base clocks have reduced a little. That reflects the fact that doubling the core count and maintaining both frequencies and power consumption, even with a tweaked 14nm+ process, is a non-starter.

As for specifics, at the bottom end of the relevant U Series range, Intel used to offer laptop makers the Core i5-7260U for US$304. For that, you got two cores and four threads clocked at 2.2GHz base and 3.4GHz Turbo. Now, Intel will sell you the Core i5-8250U with four cores and eight threads, a base clock of 1.6GHz, and a top Turbo speed of 3.4GHz. And it will set vendors back just US$297. Nice. At the other end of this U Series scale used to be the Core i7-7660U, a dual-core, quad-thread 2.5/4.0GHz model for US$415. Its replacement is the Core i7-8650U, a quad-core, eight-thread puppy rocking 1.9/4.2GHz frequencies, and costs manufacturers US$409.

If that's the good news on the mobile side, the bad is that it only adds to the incredible complexity and confusion of Intel's current product offerings. Right now, Intel lists no fewer than 144 individual mobile CPU models for sale from various generations of CPU. Just mobile CPUs, you'll note, and all based on the full Core architecture. Of those 144 models, all are either



## Whatever happened to 10nm?

With Intel stringing its 14nm production node out to at least four generations (that's generations with a small 'g') of Core processors, and having officially delayed the 10nm node, is Moore's Law dead? Moore's Law, of course, is the observation that computer chips double in complexity or halve in cost — or some mix of the two — every couple of years.

The simple answer is 'yes'. If you define Moore's Law by that rigid two-year time frame, then it's probably done and dusted. Progress with conventional computer chips will continue, but at the slower pace we're already seeing. After all, Intel's first 14nm processors went on sale in late 2014. Nearly three years later, we've yet to see any 10nm chips, even if Intel is promising them by the end of the year.

You could argue some new paradigm is needed, be that quantum computing or some other fundamentally new technology, if the next 40 years or so are to be anything like the last 40 years when it comes to the growth in computing performance. In the shorter term, however, the fact that Intel is no longer shrinking its transistors on a regular biannual cadence isn't the end of the world. Intel has shown with the 14nm process that significant gains can be had in terms of power consumption, courtesy of revising an existing process.

Of course, smaller circuit features aren't just about power consumption. They also allow more transistors to be made available, or the same number of transistors at a lower cost. But even limited access to larger transistor counts might not be a total disaster.

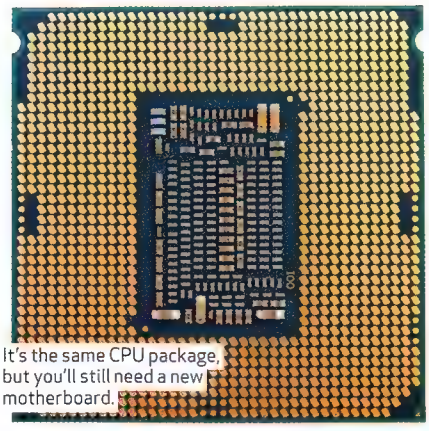
One effect of Moore's Law over the years has arguably been a certain inefficiency in chip design. Put simply, engineers have always been able to hurl more transistors at a given computational problem. But with Moore's Law coming to an end, chip designers will be much more incentivised to hone and polish their designs. Odds are, quite a bit of performance has been left on the table over the years. Clawing some of that back should buy several generations' worth of performance improvements while the industry searches for an alternative to the conventional silicon-based integrated circuit.

dual-core or quad-core. The upshot is that much of Intel's branding has become meaningless.

There are Core i5 mobile CPUs with two cores, for instance. There are Core i5 mobile CPUs with four cores. But some of them have hyperthreading and support for eight threads. Others do not. Meanwhile, customers are expected to decipher an impenetrable product suffix, with anything up to four numerals and two letters. Frankly, if you set Intel the task of creating a product lineup expressly designed to beat customers into submission with the sheer, unfathomable complexity of it all, it could scarcely be any different from the array of similar mobile CPU models it does offer.

Despite all that, the new chips are still very welcome. They shift a whole class of notebooks instantly from dual to quad-core processing. Another 8th-gen novelty first seen with these U Series mobile chips is the debut of new branding for Intel's integrated graphics. Gone is the old 'HD' moniker; in comes 'UHD'. The branding change reflects an increased emphasis on 4K or UHD resolutions. To achieve that, the new chips now natively support UHD resolutions via HDCP 2.2 content encryption and DisplayPort 1.2a connectivity. However, beyond those 2D video upgrades, the 3D graphics architecture is unchanged. That's significant. But hold that thought while we segue deftly to the desktop and the CPUs that arguably best define this new generation of chips.

We give you Coffee Lake, the family of CPUs that we'd argue is the true 8th-generation Core architecture. Once again, it's based on 14nm technology, and once again, Intel is claiming further revisions and



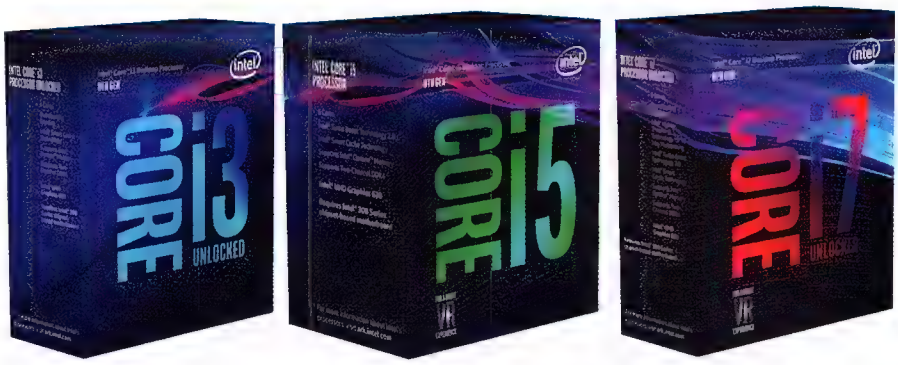
It's the same CPU package, but you'll still need a new motherboard.

advancements for its 14nm transistors. This time around, Intel is calling it 14nm++ and making some fairly bold claims. Overall, Intel says 14nm++ allows for around 24% higher drive current for 52% less power than its original 14nm process. What hasn't seemingly changed is much by way of architectural improvements. Intel isn't making big claims for things such as per-core performance. Nor has it added to the 16 native PCI Express lanes connecting the CPU to peripherals, such as graphics.

Instead, the really big news with Coffee Lake desktop chips is that they introduce the first increase in core count for mainstream Intel desktop processors since the Nehalem architecture of nearly a decade ago. Where once you got two cores, you now get four. And where you got four cores, you'll now be getting six. And you'll nearly – but not quite – get all that for the same money as before.

Intel has initially launched six CPUs, two each for Core i3, i5 and i7. The Core i3 models now offer four cores, while the Core i5 and Core i7 now pack six. If you're wondering how the latter are

"Right now, Intel lists no fewer than 144 individual mobile CPU models for sale from various generations of CPU."




The basic Core i3 now has four cores, Core i5 chips are now six-core beasts, while Core i7 models now have six cores and hyperthreading.

## What's next?

Intel's new 8th-gen family of CPUs is already pretty complicated, what with Kaby Lake refresh chips going into laptops, and the new Coffee Lake architecture for the desktop. But it's only going to get busier.

So far, all the new 8th-generation processors are manufactured using Intel's new 14nm++ silicon production process. It's basically a refined version of the 14nm process that first appeared in 2014 with the Broadwell architecture. However, next year will see the arrival of Intel's first 10nm processors, known as Cannon Lake. These, too, are expected to be marketed as 8th-generation CPUs.

Strictly speaking, Intel says it will be shipping the very first Cannon Lake CPUs by the end of 2017. But we doubt you'll be able to buy PCs or the bare CPUs until early 2018 at best. Either way, Cannon Lake is essentially a die-shrink to 10nm of the new Coffee Lake architecture. Our expectation is that it will likely be limited to mobile CPU models. For the next step on the desktop, you're talking Ice Lake.

Ice Lake is a CPU architecture that Intel has only recently confirmed to exist. It's a new architecture that will be manufactured with what by then will be Intel's revised 10nm+ transistors. Intel's says it's the successor to the 8th-generation Core family and thus will be the first official 9th-generation chip.

For now, that's pretty much all that's known about Ice Lake. Given that Intel's CPU core design has essentially flatlined of late, we're not expecting any major changes there. Instead, it's core count and the integrated graphics that offer the best opportunities for dramatic change. We'd like to see the core count increase again and, in an ideal world, see Intel ditch the pointless integrated graphics on Core i5 and i7 models in return for either lower prices or more cores.

## Pick a platform

With a new generation of Intel processors usually comes a new platform. Intel's 8th-gen Core chips are no different, even if it's too early to assume which members of the 8th-gen family the new motherboard chipset will align with.

For now, it's the six new desktop processors that are the first to be based on the Coffee Lake architecture. The new chipset they're getting is the Z370. Indeed, the Z370 is more a requirement than a gift. Officially, the new Coffee Lake CPUs will not run in older motherboards.

In some ways, that's frustrating. In most regards, the new Z370 is identical to the old Z270. It has the same broad connectivity, so we're talking up to 24 PCIe 3.0 lanes, six SATA 6Gb/s ports, with support for RAID 0/1/5/10, a total of 14 USB ports, with up to 10 in USB 3.0 spec (yup, still no native support for USB 3.1 Gen 2), and support for Intel's Optane memory as a boot drive. In fact, our understanding is that it's the same chipset, just under a new name.

The difference — or rather the reason, according to Intel, for requiring a new chipset and therefore preventing drop-in upgrades of older boards with the new Coffee Lake processors — comes down to power consumption. The new six-core models are said to guzzle more juice than the old 200 Series mobos can handle.

That's the theory. In practice, it seems as though it might just turn out that some high-spec Z270 motherboards could end up supporting Coffee Lake. According to ASUS, some Z270 'boards have sufficient power delivery to support Coffee Lake processors. All that would be needed are updates to the Management Engine and BIOS. However, this is something that Intel would have to enable. Motherboard makers would not be able to make that move unilaterally.

No new process node. No new architecture. But you do get more cores.

**"For as long as we can remember, true multithreaded gaming has been just around the corner. It's a bit like cold fusion power, AI or a cure for cancer. It's always just over the horizon, but never seems to get closer."**

differentiated, it's via hyperthreading. Only the Core i7 models get that, so only the Core i7s are 12-thread chips. For the record, the Core i3s don't get hyperthreading. Nor, incidentally, do they have the Turbo frequency boost mode. You get the base clock, and that's it.

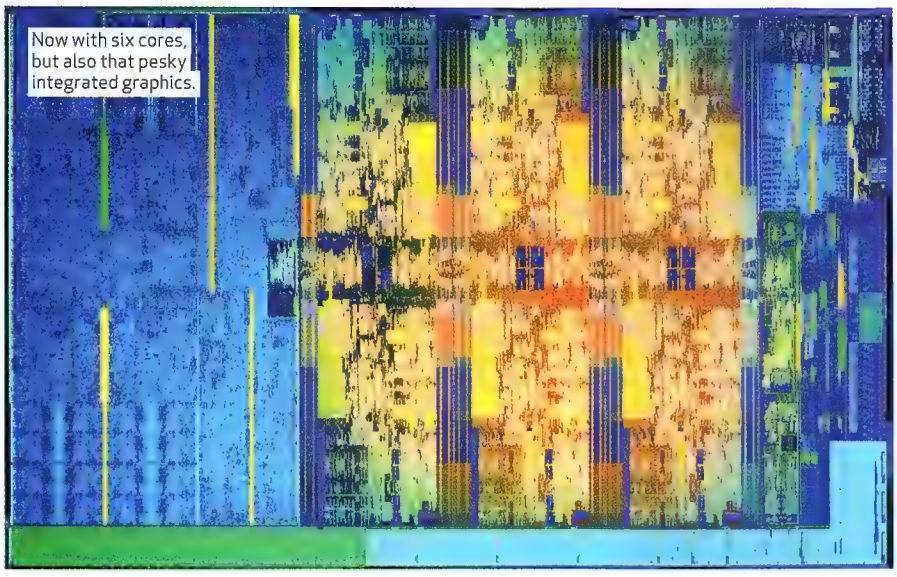
The exception to that is the unlocked 'K' model in the Core i3 range, which is fully overclockable via the CPU multiplier. In fact, there's an unlocked model of all three versions.

What's more, Intel has improved the overclockability of the K series models with more granular per-core overclocking. What it hasn't done, unfortunately, is ditch the cheapo thermal interface material (or thermal paste) that connects the CPU die to the processor lid. Soldering the lid to the die would be better for performance and overclocking, but also that little bit more expensive to manufacture.

Regards pricing, the two Core i3 chips and the entry-level Core i5 and Core i7 are all the same price as their 7th-gen progenitors, while the top Core i5 and i7 processors are a little more expensive. The other major change involves clock speeds. Peak Turbo speeds have gone up for the Core i5 and Core i7 chips, while base clocks are down across the board. But the base clock doesn't tell the whole story. For example, Intel rates the new six-core Core i5-8400 at 2.8GHz base clock. That sounds disappointing, even if it is only 200MHz below the 3GHz base clock of the earlier quad-core Core i5-7400. In practice, however, we found the 8400 runs at 3.8GHz under load across all six cores. That's just 200MHz off its top 4GHz Turbo speed.

That aligns with Intel's rating for the 8400 with all six cores loaded. You can refer to our table for the details, but thanks to the added cores, it's more important than ever to consider how fast each chip will run with all its cores under heavy load. That said, even the slowest of the new CPUs hits at least 3.6GHz with all cores loaded, while the top Core i7-8700K is rated at 4.3GHz with all six cores number crunching. In other words, Intel really is giving us the best of both worlds with these new processors. We're getting more cores, and clock speeds have only fallen off by a very small amount.

Less impressive, depending on how you look at it, are the integrated graphics capabilities we alluded to earlier. Beyond the change in branding, there's little to report. Intel hasn't revised its 3D graphics architecture for Coffee Lake. The 'new' UHD 630 graphics found in the new



Now with six cores, but also that pesky integrated graphics.

CPUs is the same in 3D rendering terms as the HD 630 in the 7th-generation Kaby Lake chips.

Is this an indication that Intel is finally giving up on integrated graphics for what you might call serious gaming? That's hard to say. What is for sure is that Intel's integrated graphics have never been any good for serious gaming, and even fall short for casual gaming with older games. There's a strong case for arguing these relatively high performance chips would be better off without the on-die graphics taking up any space at all. The Core i5 and i7 models, in particular, will almost certainly be paired with discrete graphics cards.

With that in mind, Intel could either make the six-core die smaller and cheaper by removing the graphics, then pass the cost savings on to consumers, or add more cores and create an arguably more logical and appealing CPU range, with four cores at the bottom on the i3 models, six cores for i5 chips, and eight cores for i7s. It wouldn't surprise us to see a hierarchy something like that in future generations.

While we're talking graphics, there's the question of gaming performance. For as long as we can remember, true multithreaded gaming has been just around the corner. It's a bit like cold fusion power, AI or a cure for cancer. It's always just over the horizon, but never seems to get closer.

Admittedly, with the arrival of new graphics APIs in the form of DirectX 12 and Vulkan, you could argue that the long-promised multithreaded future for gaming is now tangibly closer. And that may be true, but for now, the number of games that really make good use of more than four CPU cores registers somewhere between slim and none. With that in mind, what to make of the extra cores in Coffee Lake CPUs? For our money, it's good news however you slice it. If you're a many-cores denier, and you think four cores are plenty for gaming, the new chips get you a proper quad-core Intel desktop processor for just $179. If, like us, you think that six cores are a solid future-proofing bet, that's now a mainstream option from Intel.

Of course, while we're patting Intel on the back for finally delivering some more mainstream processor cores on the desktop, it's only fair to give its main – and, frankly, only – rival AMD the last word in all this. It's easy to imagine Intel's new-found largesse failing to materialise had it not been for the sudden uptick in competition provided by AMD's exciting new Ryzen processors.

With up to eight proper CPU cores in its own mainstream CPU socket, Ryzen packs a serious multithreaded punch. It's also much more competitive in terms of single-threaded throughput than AMD chips of late. So while it's true to say that Intel almost certainly would have increased the core count of its CPUs of its own accord eventually, it's unlikely to be a coincidence that it's happening just when AMD upped its game. Indeed, the argument that Intel's moves of late have been a direct reaction to increased competition from AMD only looks more convincing when you consider the spectacular decision to increase the core count of its enthusiast-class desktop processors from 8 to 18 in a single generation. There's no way Intel would have done that without the AMD resurgence. ■

## OLD AND NEW: SPECS AND PRICES

| 7TH GENERATION CORE I PROCESSOR | PRICE | CORES | BASE CLOCK | TURBO | TDP |
|---|---|---|---|---|---|
| INTEL CORE I7-7700K | $449 | 4/8 | 4.2GHZ | 4.5GHZ | 91W |
| INTEL CORE I7-7700 | $409 | 4/8 | 3.6GHZ | 4.2GHZ | 65W |
| INTEL CORE I5-7600K | $305 | 4/4 | 3.8GHZ | 4.2GHZ | 91W |
| INTEL CORE I5-7400 | $249 | 4/4 | 3.0GHZ | 3.5GHZ | 65W |
| INTEL CORE I3-7350K | $219 | 2/4 | 4.2GHZ | N/A | 60W |
| INTEL CORE I3-7100 | $149 | 2/4 | 3.9GHZ | N/A | 51W |

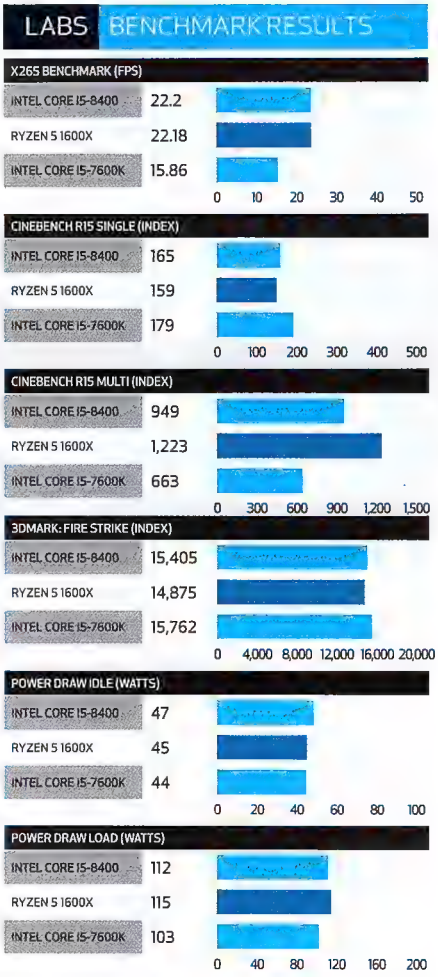
| 8TH GENERATION CORE I PROCESSOR | PRICE | CORES | BASE CLOCK |
|---|---|---|---|
| INTEL CORE I7-8700K | $569 | 6/12 | 3.7GHZ |
| INTEL CORE I7-8700 | $489 | 6/12 | 3.2GHZ |
| INTEL CORE I5-8600K | $399 | 6/6 | 3.6GHZ |
| INTEL CORE I5-8400 | $289 | 6/6 | 2.8GHZ |
| INTEL CORE I3-8350K | $259 | 4/4 | 4.0GHZ |
| INTEL CORE I3-8100 | $179 | 4/4 | 3.6GHZ |

## MAXIMUM TURBO SPEEDS BY CPU CORES UNDER LOAD

| PROCESSOR | CORES/THREADS | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| INTEL CORE I7-8700K | 6/12 | 4.7GHZ | 4.6GHZ | 4.5GHZ | 4.4GHZ | 4.4GHZ | 4.3GHZ |
| INTEL CORE I7-8700 | 6/12 | 4.6GHZ | 4.5GHZ | 4.4GHZ | 4.3GHZ | 4.3GHZ | 4.3GHZ |
| INTEL CORE I5-8600K | 6/6 | 4.3GHZ | 4.2GHZ | 4.2GHZ | 4.2GHZ | 4.1GHZ | 4.1GHZ |
| INTEL CORE I5-8400 | 6/6 | 4.0GHZ | 3.9GHZ | 3.9GHZ | 3.9GHZ | 3.8GHZ | 3.8GHZ |
| INTEL CORE I3-8350K | 4/4 | 4.0GHZ | 4.0GHZ | 4.0GHZ | 4.0GHZ | N/A | N/A |
| INTEL CORE I3-8100 | 4/4 | 3.6GHZ | 3.6GHZ | 3.6GHZ | 3.6GHZ | N/A | N/A |

INTEL CPU

$289 | WWW.INTEL.COM


LABS BENCHMARK RESULTS
X265 BENCHMARK (FPS)
INTEL CORE I5-8400 22.2
RYZEN 5 1600X 22.18
INTEL CORE I5-7600K 15.86
0 10 20 30 40 50
CINEBENCH R15 SINGLE (INDEX)
INTEL CORE I5-8400 165
RYZEN 5 1600X 159
INTEL CORE I5-7600K 179
0 100 200 300 400 500
CINEBENCH R15 MULTI (INDEX)
INTEL CORE I5-8400 949
RYZEN 5 1600X 1,223
INTEL CORE I5-7600K 663
0 300 600 900 1,200 1,500
3DMARK: FIRE STRIKE (INDEX)
INTEL CORE I5-8400 15,405
RYZEN 5 1600X 14,875
INTEL CORE I5-7600K 15,762
0 4,000 8,000 12,000 16,000 20,000
POWER DRAW IDLE (WATTS)
INTEL CORE I5-8400 47
RYZEN 5 1600X 45
INTEL CORE I5-7600K 44
0 20 40 60 80 100
POWER DRAW LOAD (WATTS)
INTEL CORE I5-8400 112
RYZEN 5 1600X 115
INTEL CORE I5-7600K 103
0 40 80 120 160 200

# Intel Core i5-8400

## More cores. Less cash. What's not to like?

**It's taken the better part of a decade, but Intel has finally upped the core count of its mainstream PC processors. Give it up for the new Coffee Lake chips!**

The big news with the Coffee Lake generation is the jump from two cores and four cores to four cores and six cores. This new Core i5-8400 replaces the quad-core Core i5-7400. So it's a six-core beast. Like previous Core i5 models, it doesn't support hyperthreading, so that's six cores and just six threads.

What's more, you don't lose out much by way of clock speeds. OK, the base clock has dropped from 3GHz to 2.8GHz, but the top Turbo frequency is actually up fairly dramatically, from 3.5GHz to 4GHz. Also, the L3 cache memory pool has grown from 6MB to 9MB. What you don't get, however, is a great deal by way of additional architectural enhancements. Intel hasn't made much noise about improvements to the CPU cores themselves, for instance. The new Coffee Lake chips are still made with 14nm transistors, just like other Intel processors dating back to the Broadwell generation in 2014, though Intel does state that Coffee Lake benefits from a revised production node known as 14nm+.

Similarly, the integrated graphics core is essentially carried over. It now runs at 1.05GHz peak instead of 1GHz, and it has better support for outputting at 4K. But as a gaming proposition, Intel's integrated graphics core seems to be stalling. It was never very convincing, but it now looks redundant. Better to remove it from the chip altogether and lower the price, or replace it with more CPU cores. After all, how many customers are going to run the likes of this new Core i5-8400 on integrated as opposed to even a low-end discrete GPU? Very few, we wager.

The final major factor to consider before we dive into performance involves platform support. Firstly, you need a new mobo, despite Coffee Lake being pin-compatible with Sky Lake. Intel says that's because the new chips require more power. However, the new Z370 chipset appears to be a rebadge of the old Z270, with no new features. Likewise, the new chips don't have additional PCI Express lanes in and out of the CPU die compared with their Sky Lake progenitors.

What isn't disappointing is performance. The 8400 clocks up to 3.8GHz with all six cores under heavy load. So you're getting a really nice combination of core count and operating frequency, considering the modest price point. That's just as well, given this is not a 'K' series model, so overclocking is not an option. But remember, these are proper, modern Intel CPU cores, the best cores in the business. From a multi-threading perspective, it absolutely blows away previous Core i5 models, and it's close enough in terms of single-threaded performance that you'd never feel the difference.

Where the old Core i5 really scored was as a gaming a CPU. As more and more games appear that make the most of the multithreading capabilities of the new DX12 and Vulkan APIs, more new titles will scale well beyond four cores. With this fantastic six-core Core i5, you're ready to cash in if and when that happens. In the meantime, you've got a great all-around CPU at a surprisingly affordable price. We like. We like a lot.

Jeremy Laird

### Verdict

| | |
|---|---|
| Features | ★★★★½ |
| Performance | ★★★★½ |
| Value | ★★★★★ |

**More of Intel's finest cores for less cash! It comes with decent clocks and superb all-around performance, too.**

★★★★½

# GEAR OF apc THE YEAR

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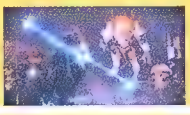
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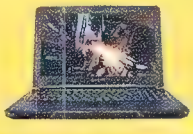
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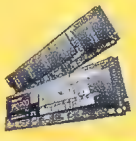
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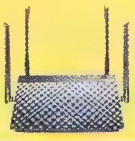
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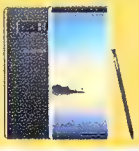
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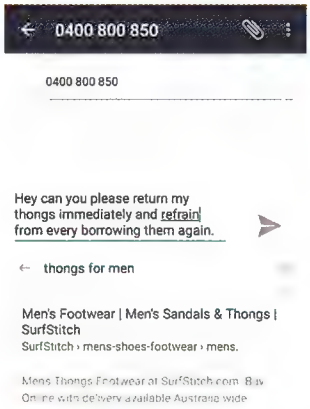
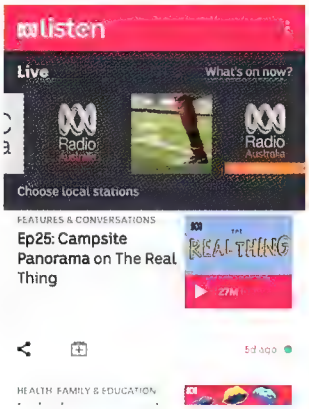
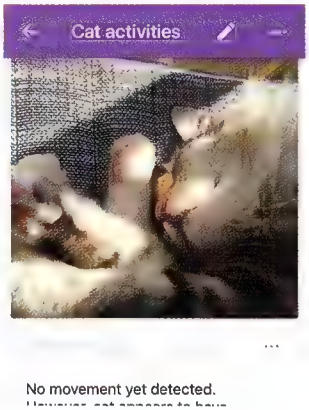
GEAR OF apc THE YEAR

# THE BEST CROSS-PLATFORM MOBILE APPS


0400 800 850
0400 800 850
Hey can you please return my thongs immediately and refrain from every borrowing them again.
thongs for men
Men's Footwear | Men's Sandals & Thongs | SurfStitch
SurfStitch › mens-shoes-footwear › mens.






## Gboard by Google

Free | goo.gl/gboard

Google successfully adds further functionality to the humble on-screen keyboard by adding web searches, weather searches and also GIF searches. When writing a text, you can tap the G logo, which allows you to embed certain links and info directly into your text without swapping apps.

## ABC Listen

Free | abc.net.au

Listen is the ABC's app for those who'd prefer to listen to audio only. You'll find pretty much every major live station in a handy scrollbar at the top. Its UI is pretty straigthforward: if you're looking for a particular podcast series (of which the ABC has many), you'll probably need to use the search function. The app also doubles as a radio alarm clock.

## BOM Weather

Free | bom.gov.au/app

An app from Australia's top weather organisation is bound to have reliable weather data. The app itself is very clean and minimalistic. Pick your location, then you're presented with a well-designed summary of the weather. The UI is user-friendly and the in-depth 'Weather for the next 24 hours' is a nice feature.

## Science Journal

Free | makingscience.withgoogle.com

Google wants you to get creative with your simple science projects. Instead of simply writing down your findings on paper, this app allows you to record audio and video clips, as well as take photos and add descriptions of witnessed results. All entries appear in a simple timeline and the overall design is very slick.

## Flipboard 4

Free
flipboard.com

This magazine-esque app brings all your news together in a single place, but a recent update has brought a more customisable experience, allowing you to personalise your feeds. You can now have subheadings under broader topics, such as a particular artist under 'music'.

## FiLMiC Pro

$22.99
filmicpro.com

An advanced video app, Filmoc Pro has a thorough suite of deep, professional controls for live colour and white balance adjustments, a dozen shooting aspect ratios, customisable dials for zoom and focus, and much more. Despite all these features, it's very accessible.

## Anchor

Free
anchor.fm

Anchor makes podcasting simple. You can post short clips by talking into your iPhone, much like an audio version of Twitter, and you can follow other 'stations' to get your daily mix of musings on just about any topic you like. There's a lot of clever stuff in Anchor that simplifies some complex workflows.

## Firefox Focus

Free
mozilla.org

This is a lightweight mobile browser that promises 'next-level privacy', but its approach is one of elegant simplicity. You can choose whether to block ads, analytics, social and other trackers individually. A trash icon appears when browsing so you can immediately erase your history and cache.

## WeDo

Free
wedo.com

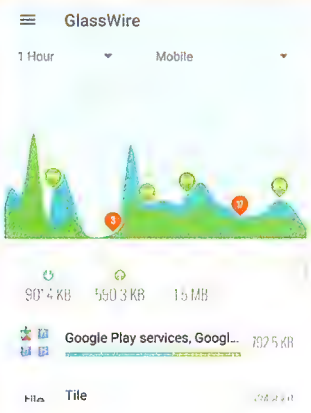
A neat productivity app that's neither bloated nor lacking crucial features. You add categories and populate them with stuff that needs to be done, and you can create events, reminders and to-do lists. You can even see what the day ahead looks like for you.

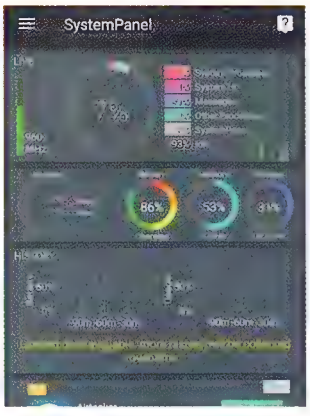
## Adobe Scan

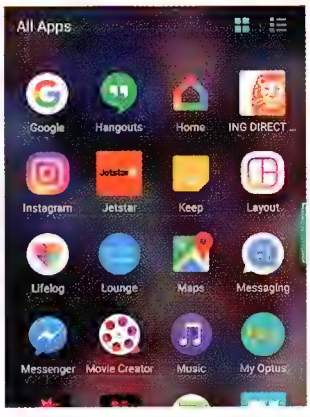
Free with IAP
adobe.com

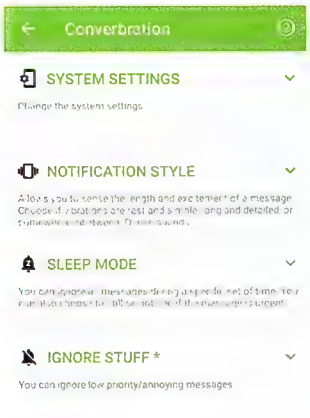
Yes, it's another app that converts pictures of documents into PDFs. But Adobe Scan justifies its existence by making great PDFs fast, with free and automatic optical character recognition, so you can search for text and copy/paste that content elsewhere. While there are in-app purchases, it works fine for free.

# THE BEST ANDROID APPS




## GlassWire Data Usage Monitor

Free | glasswire.com

If you're racing through your mobile data and frustrated with Android's in-built bare-bones management tool, you need GlassWire. A simple-to-read graph shows how much your apps are uploading and downloading up to 90 days ago and pushes out alerts when you're reaching your allowance. Everything is linked so you can easily check app settings.

## SystemPanel 2

Free with IAP | tinyurl.com/apc449-system

This app gives you an incredibly in-depth analysis of your current and past activity, allowing you to monitor and manage all your phone's applications, both user- and system-installed. The user interface is very neat and easy to read, and there's a handy stop button to halt non-critical processes.

## Evie Launcher

Free | evie.com

The Evie Launcher knows you primarily use your phone for searching, whether that's contacts, directions, apps or *Star Wars* trivia, and speeds up this instictual desire dramatically compared to regular Android. The search bar sits prominently across all of your home screens, but you can also swipe down to bring up the same function. Some saves can be saved as shortcuts, too.

## Intelligent Notifications - Converbration

Free with IAP | converbration.com

This app aims to make your phone's vibration alerts as informative as possible by replacing your stock-standard vibrations with a custom series of buzzes, which can immitate the words themselves, vary in intensity or give off a custom buzz if the content is NSFW or urgent.

## Google Contacts

Free | tinyurl.com/apc449-contacts

Google's Contacts app is finally available to anyone who doesn't have a Nexus or Pixel handset. The app has been updated to include the ability to merge duplicate entries and receive suggestions for info to add to existing ones. Everything you'd expect is there, and a whole lot more besides.

## Timbre

Free
timbre-app.com

Timbre is a suite of simple media editing tools compiled together in a single app, allowing you to do a number of nifty things with audio and video files directly from your phone or tablet. It's spartan but exceptional. You can cut, split, omit, join, convert and separate audio from video.

## Do it Later

Free with IAP
tinyurl.com/apc449-later

Schedule your emails or social media posts with this simple app. You can choose a regular scheduled item or create one to repeat, and everything will be neatly listed on the main page. Do It Later also gives you some useful reminder options, too.

## Decision Crafting

Free | tinyurl.com/apc449-decision

Can't decide where to go on your next holiday? Decision Crafting can help. Write out your options, set the criteria that defines them and give each a ranking from 1 to 10. The app crunches the numbers and spits out a purely objective, scientific suggestion. Original, simple and a weight off your shoulders.

## Bard

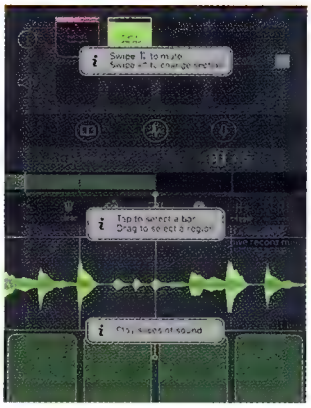
Free
bard.co

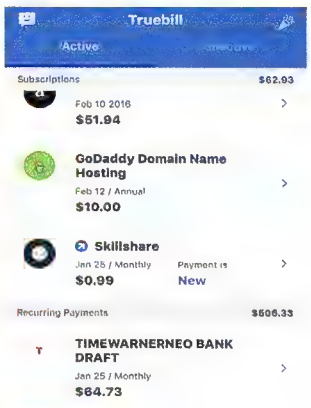
More fun than 'useful', Bard lets you rearrange the order of sections in a video to create a new (and sometimes improved) edition. For instance, chop and change the wording of a speech to alter the meaning to great amusement. Not professional quality, but fun nevertheless.

## Cinetrak

Free
cinetrak.com

Search virtually for any film and add it to your watchlist, by either looking for something specific or trawling through genres and other categories. You can rate films and 'check-in' when you're watching one, so all your friends know you're not ashamed of watching *Moana* for the tenth time.





## Blocs Wave

$4.49 | blocs.cc

Blocs Wave is designed for fast music composition and recording and is deceptively simple. You create your song as individual sections, of which you can have six, each with eight instruments. You have a tuning fork and tempo gauge, plus the ability to create your own audio to mix up as you please.

## Enlight Photofox

Free with IAP | photofoxapp.com

Photography apps are a dime a dozen, but Enlight Photofox — the latest upgrade to the Enlight iOS app — adds a Photoshop-like editor to make every image you take into a work of art. The base app is free to download, but a subscription gets you a whole load of editing tools that can add graphic elements and filters, plus the a subscription-only mode, Darkroom, is neat.

## Overcast

Free with IAP | overcast.fm

Overcast's recent makeover has made it even better than before. This is a podcast hub with a search function that turns up seemingly endless options, clumped by genre or 'most recommended'. It's simple to navigate, thanks to the new design, and the adoption of stacks that slide up from the bottom of the screen make managing your up next list that much easier.

## LookUp

$4.49 | thetangible.in

Why would you want a dictionary app? Every day, there's a new word for you to learn, accompanied by a cute illustration. It's a fantastic way to improve your vocabulary, and it's also a functional dictionary, of course. Each word of the day stays on the front page for a day, then joins a collection you can view later.

## Things 3

$14.99
culturedcode.com/things

Things 3's new minimalist interface makes to-dos a lot more adaptive and flexible with tags, checklists, subheadings, start dates and deadlines. Today and Upcoming sections now integrate iOS calendar events, and The Magic Plus button can be dragged to any location to create a new item.

## Documents 6

Free
readdle.com

Apple's Files might make Documents 6 obsolete, but it's still worth having because of its flexibility. You can download files from the web via a speedy built-in browser, add them to Documents, move and view them, zip a folder, send and much more. It works great, especially with other Readdle apps.

## Infltr

$2.99
infltr.com

If you're bored with the usual run of filters available on most photo apps, you'll need Infiltr. It comes with a few ready-to-use filters but also allows you to create your own. It's extremely easy to use, despite the subtle colour shifts, but we recommend not using the app itself to take pictures.

## Star Guide AR

$4.49
fifthstarlabs.com

Thanks to iOS 11 and Apple's ARKit, there's a new dimension to stargazing — augmented reality. The app take a deep dive into astronomy within a very user-friendly interface, stunning visuals and educational material, bringing the universe to life on your iPhone.

## Chuck

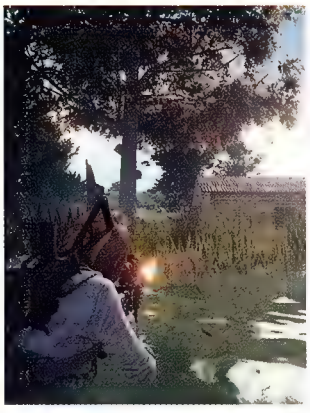
Free
chuck.email

Want a neat, clutter-free and well-tended inbox? Chuck's purpose is to gather a whole bunch of messages and chuck them out of your inbox — permanently or temporarily — so you can organise them later. It does this by grouping your mail by subject, sender and date. It can tackle multiple accounts, too.

## Lake

Free with IAP
lakecoloring.com

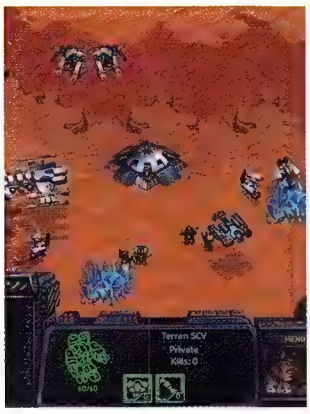
Colouring is good for the mind, psychologists say, helping us relax after a hard day's work (or during). Lake is one of the best colouring book apps out there. It's beautifully designed, extremely easy to use and even has a 'colour within the lines' tool. It's addictive, meditative and lots of fun.



## PlayerUnknown's BattleGrounds

US$29.95 | playbattlegrounds.com

Nothing short of a phenomenon. Fight to the death from a starting pool of 100, and take out your fellow man (it's online multiplayer only) with whatever you can get your hands on. Compelling and worryingly addictive, *PUBG*'s beauty lies in how simple it is.



## StarCraft Remastered

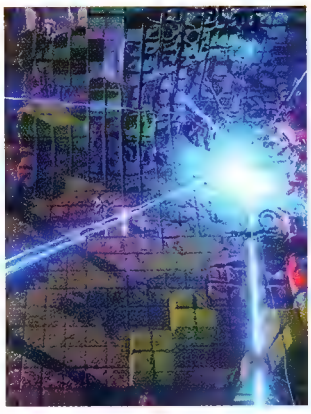
US$21.95 | starcraft.com

Blizzard's classic RTS may be 20 years old, but it feels timeless. The Remaster is cosmetic only, showing off the classic Zerg-blaster in 4K with bold new sprites. The highest compliment we can give is that it's exactly as you remember, and that's truly wonderful.

## Total War: Warhammer II

$89.95 | totalwar.com

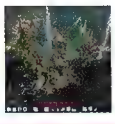
Total War: Warhammer II is starting from the point its predecessor left off. It's already a sprawling epic and the promised updates hint at something that's truly once-in-a-lifetime material. Going back to the (brilliant) original already feels impossible.



## Nex Machina

$29.95 | housemarque.com/games/nexmachina

Housemarque, widely considered the best twin-stick shooter studio in the world, probably released its masterpiece with *Nex Machina*. The twitch-oriented gameplay has real oomph, while the graphics are surreal and frantic.



## Divinity: Original Sin II

US$44.99

divinity.game

Utterly impressive thanks to its intimidating, ambitious scope, and dedication to player freedom. Developer Larian promised a lot, and it has absolutely followed through, crafting a singular RPG that juggles a bounty of complex, immersive systems, and never drops them.

## West of Loathing

US$11

westofloathing.com

Welcome to the Old West, where snakes are used as whips, cattle are demonically evil, and alongside stick-figure cowboys, there are goblins, necromancers, and ghosts. Wonderfully written, this comedy RPG is compact and a delightful way to spend a couple of dozen hours. More, please.

## Hollow Knight

US$15

hollowknight.com

This year's pinnacle 2D Metroidvania. Exploring the subterranean caverns can be overwhelming, but it also means there's almost never a wrong choice in where to go, with exciting new areas fleshing out the story.

## SteamWorld Dig 2

$29.95

imageform.se

Explore, collect, upgrade, repeat. It's a tight gameplay loop in a beautifully curated underground world, and while the encounters have been carefully orchestrated, you have total freedom in the way you best your enemies. Main character Dorothy's hookshot is a beautiful piece of kit, too.

## Rain World

$29.95

rainworldgame.com

The closest to feeling like a trapped rodent you're ever likely to get in a video game. *Rain World* is an incredibly niche and unrelentingly tough affair, but it succeeds in simulating a powerlessness few other games dare aspire to.

## Flinthook

$19.95

flinthook.com

There's no lack of sidescrolling roguelikes in the indie space, but *Flinthook* stands out for two reasons. Firstly, it's fast, fluid and using the grappling hook is fun. Secondly, it's not as brutally hard as the competition.

## Resident Evil 7: Biohazard

$89.95 | PC, PS4, XO
residentevil7.com

The first Resident Evil game to be played from a first-person perspective (or even VR on PS4), this latest entry in the action-horror series finally changes things up, delivering one of the most creepy (and gory) games of the year.

## Wolfenstein II: The New Colossus

$99.95 | PC, PS4, XO, Switch
wolfenstein.bethesda.net

*Wolfenstein II: The New Colossus* sees MachineGames at the top of its game — no one else is telling such compelling, irreverent and tender stories via the medium of FPS. Plus, lots of Nazis die, a great relief in this year 2017.

## F1 2017

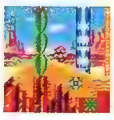
$99.95 | PC, PS4, XO
formula1-game.com

Codemaster's venerable *Formula One* series of games has been getting yearly updates since 2009, but that doesn't mean it's grown boring. This latest entry covers the 2017 season with more tight, technical racing and added depth that'll thrill genre fans.

## Destiny 2

$69 | PC, PS4, XO
destinythegame.com/

Bigger and better than the first game in every way, *Destiny 2* is the online gaming experience of the year. With a wealth of loot to acquire and new planets to explore, expect Bungie's latest opus to commandeer the next few years of your life.



## Sniper Elite 4

$99.95 | PC, PS4, XO
sniperelite4.com/en

Yes, it's the enduring series all about shooting Nazis in sensitive areas and then watching the carnage in X-ray slow motion. This instalment doesn't expand the template much, but it applies polish in all the right areas.

## Nier: Automata

$99.95 | PC, PS4
niergame.com

A surefire cult hit in the making, *Nier: Automata* is an action RPG, but it's an action RPG which feels like *Twin Peaks* set in a Hideo Kojima game. It's also surprisingly tender, for a game about slicing robots to death.

## LawBreakers

$54.95 | PC, PS4
lawbreakers.nexon.net

*LawBreakers*, at the time of writing, is a bit of a disaster: its playerbase continues to dwindle, and no amount of updates have managed to save it yet. But it's an impeccably designed competitive FPS that we hope Cliffy B can salvage.

## The Evil Within 2

$99.95 | PC, PS4, XO
theevilwithin2.bethesda.net

Departing from the original game's old-school *Resident Evil* template, *The Evil Within 2* experiments with survival horror in terms of style, but it's fairly conservative in terms of its scares. An awesome action game and a decent horror game.

## Middle-earth: Shadow of War

$99.95 | PC, PS4, XO
shadowofwar.com

Who needs friends when you have enemies like this? Go toe-to-toe with an Uruk or orc and make sure you knock him to the ground, or he'll be back stronger and harder, with a vendetta. It's a glorious system, enormously improved over *Shadow of Mordor*, and we're shocked no-one else has copied it.

## Sonic Mania

$26.95 | PC, PS4, XO, Switch | www.sega.com

An essential *Sonic* game, but how? Simple: it's been made by Sonic's biggest fan, a chap called Christian Whitehead. He's repackaged and remixed *Sonic 2* and *3* (the best 2D *Sonics*) to make something new that's guaranteed to stoke your nostalgia gland.

## Injustice 2

$69 | PC, PS4, XO
injustice.com

With a huge roster of heroes and villains to play as, *Injustice 2* is the perfect vehicle for comic book fans to live out their superpowered fantasies. Developer NetherRealm Studios has crafted a fighter that's so deep and packed with content, you could spend years unlocking everything.

## South Park

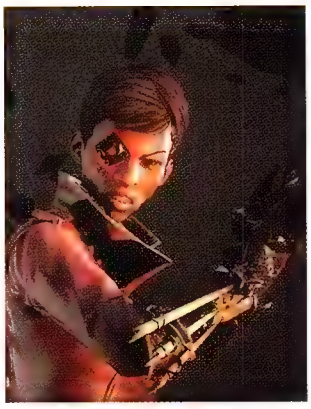
$79 | PC, PS4, XO
southpark.ubisoft.com

*South Park: The Fractured but Whole* keeps the laughs coming by turning its attention squarely towards the current superhero craze. Funnier and more profane than ever, this sequel also improves upon the turn-based RPG gameplay of its predecessor.

## Hellblade

$45 | PC, PS4
hellblade.com

Deeply moving and incredibly intense, *Hellblade: Senua's Sacrifice* explores mental illness like no other game before it. Though your journey into the Norse underworld is fraught with danger, it's the voices in your head that always cut deepest.



## Dishonored: Death of the Outsider

$39.95 | PC, PS4, XO
dishonored.bethesda.net

Following up the action in *Dishonored 2*, this standalone expansion has you attempting to take down the Outsider — essentially the Devil — which means more exploring of twisted steampunky and Mediterranean environs and the freedom to be stealthy or an outright killer.

## DiRT 4

$99.95 | PC, PS4, XO
projectcarsgame.com

In *DiRT 4*, you get to pilot several dozen of the world's best and most infamous rally cars around a limitless number of tracks, thanks to a smart generator. In terms of sheer value for money, its unbeatable, and it's wildly exciting, too.

## Project Cars 2

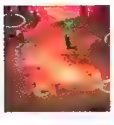
$99.95 | PC, PS4, XO
projectcarsgame.com

No other racing game dumps everything it has to offer at your fingertips and says, "Go for it. Do what you want!" Add in some terrifying and convincing weather effects (Mount Panorama in the snow, anyone?) and you have a racer par excellence.

## Prey

$99.95 | PC, PS4, XO
prey.bethesda.net

This is the game where a small dustbin can chew your face off, and at times, your best chance of survival is to transform yourself into a mug to sneak through small spaces. The fact it's a wickedly creative sc-fi shooter-puzzler is a bonus.



## Pyre

$29.95 | PC, PS4
supergiantgames.com

The studio behind indie hits *Bastion* and *Transistor*'s third game is another action RPG, this time in a high fantasy setting and with battles that have a sports-match kind of theme to them, where you need to destroy the enemy team's 'pyre'.

## Assassin's Creed Origins

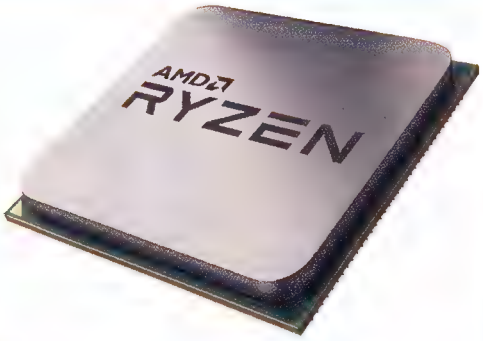
$99.95 | PC, PS4, XO
assassinscreed.ubisoft.com

In the ups and downs of the *Assassin's Creed* franchise, *Origins* is definitely an 'up'. It takes the action way back to ancient Egypt, circa 50 BC (think Cleopatra and Julius Caesar), with a huge world and an engrossing story that explores the beginnings of the series' two conflicting factions.

## Ruiner

From $24.95 | PC, PS4, XO
ruinergame.com

*Ruiner* is a title that's isometric, ultra-violent and unapologetically drenched in neo-noir '80s aesthetic. The action is fast-paced and needs a healthy dose of strategy and fast reflexes. It's rich, rewarding and sometimes punishing.




BEST BUDGET CPU
## AMD Ryzen 3 1300X
$180 | www.amd.com

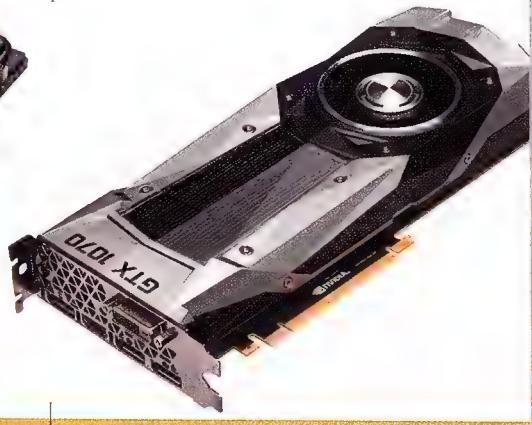
Intel and AMD both offer super-competitive CPUs at this under-$200 price point, with this Ryzen 3 1300X going up against Intel's brand-new i3-8100. Both are fast quad-core chips, but AMD's model ultimately comes away with the award for one key reason: Intel's budget 8th-generation motherboards haven't launched yet, and it's frankly silly to match a low-cost Core i3 CPU with a high-priced Z370 mobo.

BEST MAINSTREAM CPU
## Intel Core i5-8400
$290 | www.intel.com

AMD may have swept every other category in this year's CPU awards, but Intel has still managed to hold on to the all-important mainstream slot — although that's something we can probably still thank AMD for, at least in part. The Core i5-8400 might be reasonably-priced, but it's also a bit of a monster thanks to the addition of two more cores, with its 6-core/12-thread design making it unbeatable value and great for both gaming and moderate multimedia-creation tasks.

BEST PREMIUM CPU
## AMD Ryzen 7 1800X
$635 | www.amd.com

It's hard picking one Ryzen chip that's definitely worth recommending over the rest, but the top-end package that is the Ryzen 7 1800X, with its 8 physical cores and ability to handle 16 threads ultimately gets the nod. It's an incredible number-crunching powerhouse that proves AMD still has what it takes to produce a competitive chip. The initial teething problems concerning memory compatibility have been sorted.




BEST EXTREME CPU
## AMD Ryzen Threadripper 1950X
$1,299 | www.amd.com

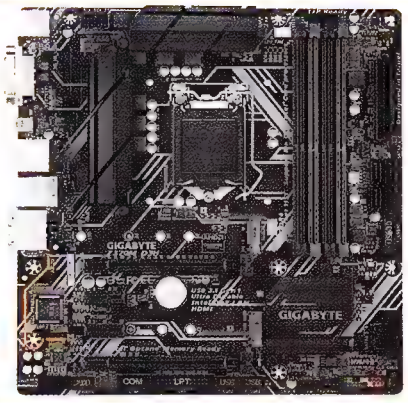
If you're a professional working in a field where data-crunching capabilities are paramount — like 3D design or image and video editing — then your choices for high-end, heavily-threaded CPUs have been fairly limited in recent years: it's been Intel or bust, basically. AMD's Ryzen changed that, and Threadripper extended that trend even further, offering a pro-oriented platform that delivers far better bang-for-buck than Intel's equivalent Core i7s. Intel still offers faster chips than this, but at eye-watering prices, making the Threadripper a far more sensible choice.

BEST EXTREME GPU
## Nvidia GeForce GTX 1080 Ti
$1,150 | www.nvidia.com

Looking to blow the budget on a top-level card? Well, you can't really put a foot wrong with the 1080 Ti. With AMD seemingly content to focus on the midrange and entry-level markets at present, there's nothing from the red team that can compete. If you're gaming at 4K or on a larger ultrawide monitor, a single 1080 Ti can net you a 60fps average in most games. So if money is no object, this one's an easy recommendation to make.

BEST PREMIUM GPU
## Nvidia GeForce GTX 1070
$690 | www.nvidia.com

If you want high frame rates or 4K gaming on a budget, this is the most economical option you'll find. The GeForce GTX 1070 will very comfortably give you 1440p/Ultra gaming on a higher-res monitor at Medium detail settings, and is the card you'll need if you're buying one of the newer ultrawide displays (but don't want to splash out on the Ti, left). The GTX 1070 is faster than its predecessor, has an ample 8GB of memory and proves to be an impressive overlocker as well, hence why it has earned its winning place here for a second year running.



## BEST MAINSTREAM GPU
### Nvidia GeForce GTX 1060 (6GB)
$400 | www.nvidia.com

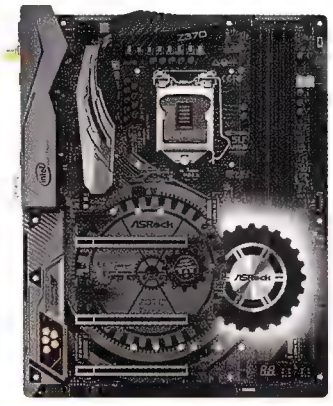
It pains us slightly that we can't recommend any AMD graphics cards in this feature, but the cryptocurrency mining craze has inflated the prices of many GPU lines, particularly on AMD's most popular cards. So if you've got around $400 to spend, the 6GB version of Nvidia's GTX 1060 is basically unbeatable, with excellent performance and enough RAM to future-proof you for at least a couple of years. That said, if you've only got $350, AMD's RX 570 is a solid alternative.

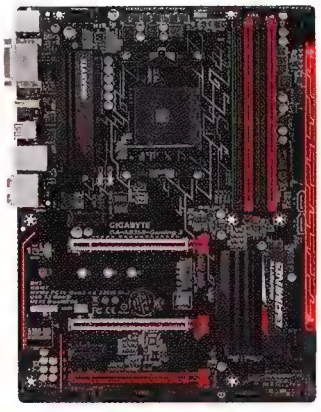
## BEST BUDGET GPU
### Nvidia GeForce GTX 1050 Ti
$210 | www.nvidia.com

For budget gamers, what you're aiming for is a card that can average around 60fps at 1080p in modern games — and you can generally get that with the $210 GeForce GTX 1050 Ti... well, provided you turn the detail settings down to Medium/Normal. It's based on Nvidia's current Pascal architecture, so cut from good stock. With 4GB of VRAM, it's 15–20% faster overall than the regular 1050, making it much more futureproof and, in our book, worth the extra cost.

## BEST BUDGET INTEL MOTHERBOARD
### Gigabyte GA-Z370M-D3H
$209 | www.gigabyte.com.au

It's a bit of a stretch to call this Z370 motherboard 'budget' at its $210 price point, but as Intel is yet to release its entry-level and midrange chipsets to go with its new 8th-gen CPUs, all the compatible mobo are at least $200. We reckon it's worth spending $10 more on this micro-ATX model over its full-sized GA-Z370-HD3 sibling, as it has a better configuration when it comes to USB ports (with seven USB 3.1s on the rear as opposed to only four) and an extra M.2 socket.





## BEST MIDRANGE INTEL MOTHERBOARD
### ASRock Z370 Taichi
$284 | www.asrock.com

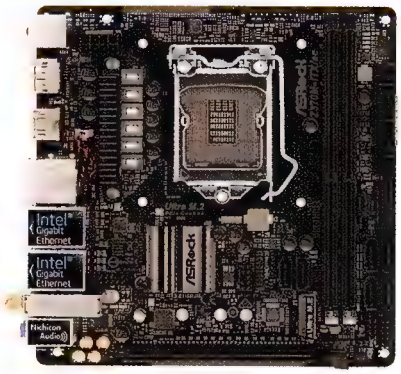
If you're looking for a motherboard to pair with the excellent Intel Core i5-8400 on the opposite page, this mid-range option from ASRock has excellent build quality, with steel-reinforced PCIe slots to help hold even the heaviest of graphics cards and if feature-packed, with twin Gigabit LAN ports and 802.11ac Wi-Fi, three M.2 storage ports (though one is only SATA), and it's also very minimal on the RGB lighting — something that we'll gladly leave out to get actually-useful additional features (or to save a bit of dosh). Great value for the price.

## BEST PREMIUM INTEL MOTHERBOARD
### MSI X299 SLI Plus
$449 | au.msi.com

With some options costing over $1,000, it's possible to spend a buttload of cash on an Intel X299 motherboard to go alongside one of Intel's new Skylake-X or Kaby Lake-X CPUs (all super high-end Core i7s and i9s), but this more-affordable 'board from MSI doesn't skimp when it comes to performance. It's got all the basic features anyone could want, though it doesn't offer the premium extras seen in its $1,000 competitors, such as dedicated DACs. Honestly, though, you don't need 'em.

## BEST BUDGET AMD MOTHERBOARD
### Gigabyte AB350-Gaming 3
$169 | www.gigabyte.com.au

Couple an entry-level Ryzen 3 or 5 chip with this very-affordable motherboard and you'll have yourself a suprisingly capable all-rounder for not a lot of dough. Gigabyte has crammed a heap of functionality onto this AMD B350-chipset offering, with a good array of USB 3.1 ports, support for multiple GPUs and DDR4-3200 memory and a dedicated audio amp just for headphones. Its performance is up there with the best B350s on offer, too, so you're not missing any beats there either.



BEST MIDRANGE AMD MOTHERBOARD
## ASUS RoG Crosshair VI Hero
$369 | www.asus.com/au

ASUS's Crosshair VI Hero became our go-to 'board for testing Ryzen thanks to its excellent memory support (an early problem for AMD's new platform), awesomely tweakable BIOS and huge range of features. There's a shedload of inputs and outputs on the rear I/O including USB 3.1 Type-A and C and buttons for clearing the CMOS or restoring a working BIOS, plus Intel Gigabit LAN, a PCIe gen-three M.2 slot and ASUS's high-quality SupremeFX S1220 audio codec.

BEST PREMIUM AMD MOTHERBOARD
## ASUS Prime X399-A
$579 | www.asus.com/au

There's relatively slim pickings when it comes to motherboard choices to go with AMD's top-end Threadripper CPUs (about a dozen at last count), but what is out there is actually quite compeititve. Prices stretch up a few hundreds dollars above this X399-A's pricetag, but don't let that fool you: this ASUS 'board is feature-packed, with a highly-tweakable BIOS alongside great memory and storage support — everything you need for a solid and grunty workstation.

BEST MINI-ITX MOTHERBOARD
## ASRock Z370M-ITX/ac
$209 | www.asrock.com

Mini-ITX has a dedicated following among PC enthusiasts and ASRock's Z370M-ITX/ac shows that you don't have to compromise just because you want to build a more-compact system. Supporting Intel 8th-gen chips, this little doer packs in dual Intel Gigabit NICs, an M.2 storage slot, six SATA ports and six USB 3.1s, plus there's even integrated 802.11ac Wi-Fi. And that price is outstanding, too.

BEST BUDGET PC CASE
## NZXT S340 Elite
$149 | www.nzxt.com

This case is both reliable and great value for money. We love its looks, with its tempered glass side panels, tight lines and powder-coated finish making for some great-looking systems. The black-and-white cable management bar looks great, but there's also the option for coloured variants, which are just as stunning. The fact that the top I/O connectors include an HDMI pass-through for VR connections is the icing on the cake. A lot of case for not much money.

BEST PREMIUM PC CASE
## Bitfenix Shogun
$250 | www.bitfenix.com

For a high-end build, you want a case that stands out from the crowd but also keeps everything inside nice and cool. The Shogun definitely ticks those boxes and supports varied cooling options. It sports slanted tempered glass side panels, while the RGB LED-lit SSD mounting panel means that your drives can put on a display while also hiding those PSU cables. There's plenty of room to build in here, too. A very attractive case for those who have the cash.

BEST MINI-ITX PC CASE
## Phanteks Enthoo Evolv ITX
$120 | phanteks.com

We're big fans of Phanteks' Enthoo line of cases generally, and this more compact option managed to match its bigger-sized siblings where it counts. It's a pleasure to work in thanks to Phanteks' great eye for detail, with lots of handy inclusions (such as dust filters on intake fans and Velcro straps for keeping stray cables in check) and commendable build-quality and material selection. Airflow is likewise first rate and we love the look — and it's quite inexpensive, too.

BEST GAMING MONITOR

## ViewSonic XG2703-GS

$899 | www.viewsonic.com

This 27-incher from ViewSonic uses a higher-than-average 2,560 x 1,440-pixel resolution, making it ideal for general usage and gaming alike. The 144Hz panel can be overclocked to 165Hz using G-Sync and features all the key components of its closest competitor the ASUS's PG279Q (reviewed in issue 447, page 40), while managing to come in at $200 less. You'll need a powerful GPU to make the most of the IPS display's QHD screen and 4ms response time, but it's a compelling offering if you can.

BEST PROFESSIONAL MONITOR

## ASUS ProArt PA328Q

$1,499 | www.asus.com/au

This monster 32-inch 4K IPS panel is as vivid as your dreams with 10-bit colour reproduction that's generated by an 8-bit panel and some clever temporal dithering. The colour gamut is pre-calibrated to meet 100% of the sRGB and Rec.709 profiles and comes with a guarantee for industry-leading colour fidelity. The user-friendly control mechanism, a 350cd/m$^2$ brightness and 100 million to 1 contrast ratio are some of the bonuses that make it our pick of this year's professional monitors.

BEST BUDGET MONITOR

## ViewSonic VX2457-mhd

$169 | www.viewsonic.com

Nvidia's expensive licensing fees for G-Sync means that, often, the best bang-for-your-buck monitors sporting AMD's screen tearing workaround Freesync and the Viewsonic VX2457-mhd is no different. The screen has an expected 1,920 x 1,080-pixel Twisted Nematic display that is notably more responsive (1ms response time) than similarly priced IPS panels and includes a bolstered 75Hz refresh rate. You'll need to bring your own DisplayPort cable to use the Freesync capabilities, but all up an impressive budget panel.

BEST LAPTOP MOUSE

## Logitech MX Anywhere 2S

$90 | www.logitech.com

Logitech's push this year was to add cross-computer compatibility to its wireless keyboards and mice, which made our favourite laptop mouse even more appealing. It's $10 more than last year's MX Anywhere 2, but the added multi-computer compatibility allows seamless scrolling across PCs as if they're screens on the same system, so it's worth a bit extra in our eyes. After all this mouse does maintain the three-week-lifespan rechargeable Li-Po battery, nearly faultless tracking and USB dongle or Bluetooth connection of its predecessor.

BEST USB LAPTOP DOCK/HUB

## Kensington SD4600P USB-C Dock

$250 | www.kensington.com/au

With laptops getting ever slimmer and ports, therefore, getting smaller (and in some cases 'fewer', too), the need for a well-stocked USB dock or hub to go with a new notebook is perhaps greater than ever. The Kingston SD4600P is just that, and designed for USB-C laptops or 2-in-1s, with two video-outputs (HDMI and DisplayPort) with up to 4K res support, Gigabit Ethernet, three full-sized Type-A USB 3.1 ports, plus mic and headphone ports on the front. And it can even power a laptop up to 100W via USB-C too.

BEST PROFESSIONAL MOUSE

## Logitech MX Master 2S

$120 | www.logitech.com

Stylistically, very little has changed since Logitech's first multi-tasking extraordinaire. The MX Master 2S boasts an impressive array of assignable buttons and wheels and carries forward the uber-ergonomic form factor that is both a wonder to behold and a wonder to be held. This mouse's point of difference is its compatibility with Logitech Flow, allowing you to fluidly switch between different computers, no matter the OS, using Logitech's software so you can continue working without a hiccup and even drag and drop files via a shared Wi-Fi connection.

## BEST PRINTER (BUDGET)
### Canon Pixma MG2960
$36 | www.canon.com.au

The Canon Pixma MG2960 inkjet can print, scan and copy in colour, plus send black-and-white faxes. It has USB and Wi-Fi that supports the Pixma printing app, Apple AirPrint and Google Cloud Print. The unit boasts a 4,800 x 1,200dpi resolution, and can handle up to 100 sheets and prints at 8.8ipm B&W, and 4.4ipm in colour. Perfect for documents, and only OK for photos. The scanner has autofeed functionality and can makes copies of up to 99 pages in one batch.

## BEST PRINTER (MIDRANGE)
### HP Officejet Pro 8710
$178 | www.hp.com/au

Whilst being rather large at 49.9 x 40.5 x 31.6cm, the 8710 is actually on the smaller side of the OfficeJet 8700 range. Print, copy, scan and fax functions are fed by a 50 sheet document copying tray and this printer includes more advanced features like double-sided printing and wireless connectivity. At four pages per minute, it's super fast, and though this means that the quality suffers, it's actually pretty good for a printer at this price.

## BEST WEBCAM
### Logitech C922
$129 | www.logitech.com

Late in 2016, Logitech's C922 dethroned its long-reigning forbear the C920 as the best webcam available. The C922 adds 60fps streaming capabilities at 720p to the already extensive feature set of the C920 and shows it's clued into the booming streaming market by bundling in a three-month XSplit subscription and a popular background-customisation software. The 1080p, 30fps high-quality streaming, advanced low light capture, dual omnidirectional mics and included tripod are the added extras that really make this webcam the one to beat.

## BEST GAMING KEYBOARD
### Corsair K70 RGB Rapidfire
$195 | www.corsair.com

Featuring Cherry's new Silver MX Speed switches (basically Reds with a shallower activation point and key travel) and a customisable polling rate, the K70 RGB Rapidfire is gunning for speed demons. The shallow key mechanics give the key caps shorter skirts, which are then drenched in colour from the customisable per-key RGB to make for a unique overall aesthetic. It's a little lighter than many boards with palm rests at 1.09kg, but good software-based macros and a sturdy key feel, quash any doubts.

## BEST GAMING MOUSE
### Razer DeathAdder Elite
$99 | www.razerzone.com

While this series has always been popular with us here at *APC*, an updated 16,000dpi optical sensor adds a new level of fidelity to this already exceptional gaming mouse. This year's new mechanical switches are a little quieter and feel nicer than previous offerings. It's still on the lighter side at 105g, but with a dpi toggle, mappable thumb buttons and all the customisable RGB lighting, you'd expect it's still our top pick of the gaming mice.

## BEST WIRELESS GAMING MOUSE
### Logitech G703
$149 | www.logitech.com

Logitech showed how far ahead of the competition it was this year, launching an induction-based wireless-mouse charging mat. Compatibility with this mat is one of the main selling points of the G703, but with a 1–2 week lifespan on its rechargeable battery and an easy to connect 1.8m charging cable, it actually works perfectly well without the Powerplay charging mat. With a 12,000dpi optical sensor, 6-button configuration and dual RGB lighting, it's a great untethered option.

BEST GAMING HEADSET
## Cougar Immersa Pro
$99 | www.cougargaming.com

Headphone 7.1 surround sound isn't the same as what you get with a full speaker array, but the Cougar Immersa Pro offers a number of 3D sound functionalities for a fraction of the cost of multi-speaker surround sound. The two 50mm drivers do a good job with audio reproduction, pushing full bass notes and warm mids. You lose a little clarity in the higher frequencies, but a comfy fit, customisable LED lights, USB or 3.5mm audio interface, and earcup volume dials make for a hard-to-beat headset.

BEST GAMING CAPTURE CARD
## Razer Ripsaw
$240 | www.razerzone.com

The Razer Ripsaw is one of the few capture devices targeted at providing a solution for the gamer looking to record from anything to everything. You can plug the Ripsaw in and play straight from one rig into another. And it's fairly painless to set up. Our testing found the Ripsaw wonderfully consistent, with recordings crisp and sharp. Despite not having the option of capturing footage above 1080p, using the Ripsaw makes for a surprisingly enjoyable experience.

BEST VR KIT
## HTC Vive
$999 | www.vive.com

The race has tightened since last year with Oculus releasing its touch controllers, ramping up its exclusive game offering and even announcing some interesting new headset iterations at the end of 2017. That said, HTC's better screen, headset tracking and third-party compatibility workarounds still give it a slight edge over the Facebook VR faction. Whilst the headset hasn't changed since its launch, it did receive a $300 price reduction in response to Oculus Summer Sale, making it that little bit more approachable.

BEST LAPBOARD
## Razer Turret
$219 | www.razerzone.com

While there are arguably better lapboard typing experiences to be found for the same price, the Turret is a compact unit that gives you all the essentials without dominating your living room. Sadly, you won't be able to dim your house lights, as the Turret misses out on any backlighting, but this does allow for a totally wireless experience, an attribute that is surprisingly rare in lapboards. To top it off, the mouse and keyboard's rechargeable batteries will last around 40 hours, which is more than enough to be convenient, and the mouse mat is handily magnetised.

BEST PC GAMEPAD
## Sony PlayStation DualShock 4
$99 | www.playstation.com

While the Xbox Elite Wireless Controller is undoubtedly our favourite gamepad for the PC, $200 is more than most will want to spend. At less than half the price, PlayStation's DualShock 4 is compatible with your PC, after jumping a few Bluetooth hoops, and will give you all the functions you need from a PC gamepad. Many people will already have DS4 controllers that can be repurposed when required, but for those without a console, these controllers are still more durable than the majority of the competition.

BEST PERIPHERAL WE DIDN'T SEE COMING
## Samsung CHG90 QLED Gaming Monitor
$2,499 | www.alienware.com.au

It's like two premium monitors for the price of two. Yes this 1.2m widescreen monitor is a little ridiculous, but it's also the perfect single-screen gaming monitor. The 49-inch, 32 x 9, super-ultra-widescreen display is really just two 27-inch displays fused at the hip for a seamless screen setup. There's also a 3,840 x 1,080 resolution display, Freesync compatibility, a 144Hz refresh rate, 1ms response time and 1.8m radius curvature, to keep every inch of your eyeballs bathed in HDR quantum dot illumination.

BEST ULTRABOOK

## Dell XPS 13

From $1,999 | www.dell.com.au

Dell has largely stuck with the same XPS 13 chassis design for the last few years now, but there's a reason for that: it's an appealingly compact little unit made from a tough mix of aluminium and carbon fibre that looks great and weathers well. It's top-notch in use, too, with a first-rate keyboard and trackpad combo and the option of a 4K screen — not that you really need it on a 13.3-inch display. Lastly, the XPS 13 has one of the longest-lasting batteries for a Windows laptop we've seen, so this is genuinely an 'all day' notebook.

BEST BUDGET GAMING LAPTOP

## Gigabyte SabrePro 15

$2,250 | www.gigabyte.com.au

'Budget gaming laptop' is something of a non-starter in many senses, because it's almost impossible to find a decent gaming GPU in a system under $2,500. This Gigabyte model manages that, with a GeForce GTX 1060 that can drive its games along on its 1080p display at a reasonable clip. And this model is well-balanced elsewhere, too, with a 256GB SSD and 1TB hard drive for storage, Core i7 CPU and 16GB of RAM. It's not the fastest gaming system, but you'll be hard pressed to find better value this close to $2,000.

BEST PREMIUM GAMING LAPTOP

## HP Omen 17-an059tx

$3,499 | www.hp.com/au

If you're going to go the whole hog and spend big on a gaming laptop, it might as well be something like this 17-inch unit from HP. This specific model delivers amazing value, especially considering its brand-name heritage, with an Nvidia GeForce GTX 1070 graphics processor, 512GB NVMe SSD plus 1TB hard drive, Core i7 processor and 16GB of RAM — all the basics you need for good gaming speed. That display is a classy number, too, with 120Hz refresh allowing buttery-smooth frame rendering.

BEST BUDGET LAPTOP

## Acer Aspire E5-575-539R

$699 | www.acer.com.au

Acer's Aspire range includes some solid offerings at this budget end of town, with select retailers selling this 15.6-inch model for a reasonable $699. You get the basics: a passable 1,366 x 768p LCD screen, Core i5 CPU, 8GB of RAM and a 1TB 5,400rpm hard drive running Windows 10 Home. What you don't get is something that's particularly portable — at 2.2kg, it's getting on the heavy side, and the tiny battery doesn't last very long; you'll be luck to get a couple of hours before needing to recharge. Still, the value here is undeniable.

BEST PREMIUM LAPTOP

## Dell XPS 15 (2017)

$2,999 | www.dell.com.au

This category was a surprisingly hard pick, but ultimately, we reckon the bigger version of our recommended ultrabook (Dell's XPS 13) strikes the best balance between portability, performance and price. We think the $2,999 unit is the pick of the four models available, as it packs a 15-inch 4K display with a just-fast-enough GTX 1050 graphics chip that can handle a little gaming and a 512GB SSD, which has enough space for comfort. It was on special for $2,499 at the time of press, so you might want to wait for a similar discount.

BEST CHROMEBOOK

## ASUS Chromebook Flip

$800 | www.asus.com/au

Chromebooks haven't quite taken off in Australia like they have in some other Western markets, meaning the choices on offer locally are a little slim — but that doesn't mean there aren't any good models on offer, mind you. This 12.5-inch unit from ASUS is technically a 2-in-1, with a screen that folds around so you can use the device like a tablet, and it's 1080p display is bigger and higher-res than most others. It does cost more, but if you want the best Chromebook available, this is the one.

BEST BUDGET TABLET

## Apple iPad (2017)

From $469 (32GB) | www.apple.com/au

While Aussies' love-affair with tablets might have cooled from the heydays of 2013, we reckon they're still appealing for certain uses — and this entry-level iPad is hard to argue with at just $469. That price rivals most name-brand Android options, and although the latter platform has come a long way on tablets, we still reckon iOS is the better choice for this form-factor, with more tablet-specific apps and games on offer, and lots more third-party accessories to choose from.

BEST IOS TABLET

## Apple iPad Pro 10.5-inch

From $979 | www.apple.com/au

Apple slightly upsized its 9.7-inch iPad Pro in 2017, giving us this 10.5-inch option that we think hits the sweet spot between portability and usability. It's got blazing-fast internals (rivalling the latest MacBook Pro in some regards), so apps and games run fast and lag-free and switching between them with iOS 11's new multitasking capabilities is super smooth. There are some great keyboard accessories for the 10.5-inch iPad Pro, too, and it works with Apple's Pencil stylus for drawing and writing.

BEST WINDOWS TABLET

## Microsoft Surface Pro (2017)

From $1,199 | www.microsoftstore.com

Microsoft has dropped the number from this year's Surface Pro (technically the fifth) and it's mostly a pretty subtle update over the Pro 4. You still have a choice of models ranging from $1,199 all the way up to $3,999 (and a Type Cover keyboard will add $250 to that, for those that want to turn it into a 2-in-1). But you'll still find no better a Windows tablet in terms of build quality and all-round usability, with a fabulous stylus, fantastic screen and first-class performance.

BEST ANDROID TABLET

## Samsung Galaxy Tab S3

From $949 | www.samsung.com/au

Though it's almost identical to its predecessor in terms of specs, the Samsung Galaxy Tab S3 now offers S Pen functionality and a fetching new design — its glass backing feels slick in the hand, if a bit fragile. While it doesn't have many competitors these days, the Galaxy Tab S3 is undoubtedly the best Android tablet available at the moment. Those looking for an iPad alternative running Android needn't look any further.

BEST BUDGET 2-IN-1

## Acer Switch 3

From $799 | www.acer.com.au

If you're looking for a tablet/laptop hybrid that won't break the bank, this detachable 2-in-1 costs a good 30% less than the nearest Surface Pro (and the latter doesn't even come with a keyboard case as standard) but covers all the basics and even includes a stylus to work with Windows excellent pen input capabilities. It only has an Intel Pentium CPU, but for the price, this is a great all-round 2-in-1.

BEST PREMIUM 2-IN-1

## HP Spectre x360 13-ac068tu

$2,100 | www.hp.com/au

The HP Spectre x360 took out the award for this category last year too, and though many other premium 2-in-1s have launched since, this is still our favourite. Its slim and classy chassis design remains the same as last year, but there are faster internals alongside very long battery life. It's quick in use thanks to a speedy PCIe SSD and even capable of tasks like video editing. Note that there are a few different x360 configurations and sizes available — we think this specific 13-inch model is the best pick, but there are cheaper/faster options.

BEST PORTABLE STORAGE (PREMIUM)

## Samsung Portable SSD T5

From $189 | www.samsung.com/au

Samsung's been the one to beat in portable flash-based based storage for some time now, and although the T5 isn't the quantum leap that the T3 and T1 were, it still trims some time off transfer speeds. You can actually get the T3 models now for $60 less, if you're willing to lose 10–20MB off the T5's 437/444MB per second read and write speeds. For the fastest rates possible, though, the T5 is the go-to portable SSD.

BEST PORTABLE STORAGE (BUDGET)

## WD My Passport 1TB

$89 | www.wd.com

WD's latest My Passport is taking the low ball approach with its updated My Passport range, selling its 1TB models at the lower end of market value. While you can still find elemental drives for a similar price or less, WD's My Passport Range comes with security and backup software bundled in. With sustained read and write speeds of 114.5/110.1MB per second, the new My Passport isn't particularly fast across portable HDDs, but it's good for a budget drive.

BEST WIRELESS PORTABLE STORAGE

## WD My Passport Wireless Pro 2TB

$285 | www.wd.com

Mostly geared towards content creators like photographers and videographers, many of its features make it easy to share large files. It has up to 10 hours of battery and select devices can transfer images straight to the Pro without a PC. Connectivity is great, with a built-in SD card reader and USB host port. The Pro comes with the Plex Media Server and it's compatible with iOS, Android, Mac and Windows. It's even come down in price considerably since last year.

BEST EXTERNAL DESKTOP STORAGE (PREMIUM)

## WD My Book 8TB

$350 | www.wd.com

WD's latest range of desktop hard drives might lack the handy front-facing USB port feature offered by Seagate's Backup Plus Hub, but at this bigger 8TB capacity, WD's product is a little more affordable and, moreover, is better when it comes to one critical area — speed when writing lots of mixed files, both small and large, which is the case when performing full PC backup jobs. That extra bit of performance makes it a slightly superior choice in our estimates, and WD's included software is also very polished and user friendly.

BEST EXTERNAL DESKTOP STORAGE (BUDGET)

## Seagate Backup Plus Hub 4TB

$200 | www.seagate.com

Naturally, the front-facing dual USB 3.0 ports on this desktop drive are the distinguishing feature, allowing easily accessible charging or quick backup connections, but the Backup Plus Hub excels in a number of other ways as well. Read and write speeds of 198/188MB per second peg it above many smaller HDDs speeds and the price-to-capacity ratios are unbeatable in value. It even looks pretty good for a desktop external storage unit.

BEST INTERNAL NAS HARD DRIVES

## Seagate IronWolf

From $100 | www.seagate.com

If you're after internal hard drives to populate a consumer or small-business NAS, Seagate's IronWolfs remain our favourites. They're very competitive in terms of gigs per dollar — anything from 3TB upwards costs around 20c (or less) per gigabyte, and that value actually gets better at the highest 10TB and new 12TB capacities, which are around 18c and 17c a pop. They all include a 3-year warranty as standard, too. It's worth noting that the larger models (6TB and over) are actually faster 7,200rpm drives; anything below that is 5,900rpm.

BEST 2-BAY NAS BOX

## QNAP TS-228

$190 | www.qnap.com

This affordable two-bay NAS is a great way to add failsafe backup capabilities to your home or office without breaking the bank — and it's still feature-packed, despite that bargain price point. You can install a range of apps to expand the TS-228's out-of-the-box capabilities, although the latter are already quite extensive to be honest, including hybrid cloud backup, media serving tools and the ability to manage networked security cameras. This is a powerful little box that packs a heap of functionality.

BEST 4-BAY NAS BOX

## Synology DS916+

$690 | www.synology.com

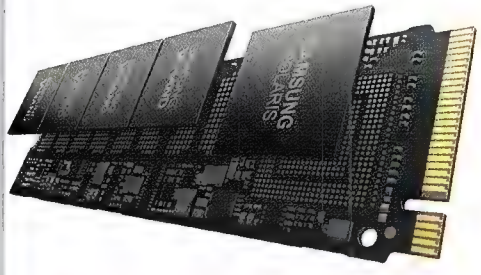
NAS shelf-lives are longer than many other tech products, and the Synology DS916+ is actually the same model we recommended here last year. It's not the cheapest four-bay around, but that's due to it being a performance-oriented device with high-end transcoding abilities courtesy of a quad-core Intel Prentium N3710 CPU (one of the fastest we've seen in a NAS) and is available with either 2GB or 8GB of RAM. Setup is quick and tool-less, transfer speeds were fantastic in our testing and the OS is feature-packed and highly expandable.

BEST 5-BAY (OR BIGGER) NAS BOX

## Synology DS1517+

$1,099 | www.synology.com

If you need a truly big NAS that allows for masses of storage, this five-bay unit is our current pick. It runs Synology's excellent DSM operating system, supports the very latest 12TB hard drives (conceivably letting you outfit it with up to 60TB of storage) and offers top performance thanks to a quad-core Intel Atom CPU and 8GB of memory. If you need even more performance, you can also optionally add caching SSDs or 10 Gigabit Ethernet via an expansion card. A great option for those that need speedy, failsafe storage for the home or a small office.



BEST INTERNAL SSD (PREMIUM)

## Samsung 960 Pro M.2 (512GB)

$430 | www.samsung.com/au

If Samsung wasn't so far ahead of most other SSD-makers, you could probably accuse the company of resting on its laurels. This NVMe PCIe drive was released in late 2016, but it still rules the roost, with read speeds of over 3,000MB/s and writes approaching 2,000MB/s. It uses Samsung's own Polaris controller chip, which helped deliver a 40% speed increase on top of the previous-gen 950 Pro drives. If you need the fastest consumer SSD money can buy, you can't go wrong with a 960 Pro.

BEST INTERNAL SSD (MIDRANGE)

## Samsung 850 EVO (500GB)

$220 | www.samsung.com/au

Samsung is very hard to compete with when it comes to SSDs, and that's because it makes basically every component that goes inside its drives. The 850 EVO range technically hasn't been refreshed since 2016, but it doesn't need to be. These SATA drives (available in both M.2 and 2.5-inch flavours) basically max-out the SATA interface when it comes to performance, with reads and writes both up above 550 and 530MB/s, respectively. Given this drive is one of the most-affordable 500GB models, it's a no-brainer.

BEST INTERNAL SSD (BUDGET)

## Crucial MX300 (275GB)

$130 | www.crucial.com

It's a testament to how good Crucial's MX300 SSD range is (and how little the SSD market has changed) that this same 275GB model is what won this category award last year. This is a fast little SATA 6Gbps drive that maxes out that socket's available bandwidth (meaning read and write speeds of around 550MB/s) and it's a drive you can find in either 2.5-inch or M.2 form factors, covering both main SSD use cases. If you can stretch another $80 or so, the 525GB MX300 is even better value in terms of bang for buck.

BEST MESH GEAR
## Netgear Orbi (Kit of Two, RBK50)
$560 | www.netgear.com.au

Mesh routers are a new category that take the concept of wireless extenders and make it work like it's supposed to. A mesh kit typically comes with a main router and one or more satellites, with the latter being placed around the home (or office) to boost a wireless signal. Google, Linksys and TP-Link all have decent kits, but we reckon Netgear's Orbi range is currently the best option, with a dedicated wireless 'backchannel' for the devices to communicate with each other, which help boost speeds and signal strength.

BEST BROADBAND ROUTER
## ASUS RT-AC88U
$425 | www.asus.com/au

This whale of a router has a largish footprint, but that does come with perks, including four large antenna to power its 4 x 4 802.11ac MU-MIMO Wi-Fi, plus double the usual number of Gigabit Ethernet ports, for eight in total (or nine including the WAN port). ASUS's built-in traffic-management (aka 'Quality of Service') feature is good at ensuring gaming and video-streaming are kept lag free, and there's heaps of enthusiast extras on offer that most other mainstream-brand routers ignore.

BEST BUDGET BROADBAND ROUTER
## TP-Link Archer C7
$150 | www.tp-link.com.au

Chinese networking company TP-Link's general approach is to give you a lot of router for not a lot of money, and that applies very well to this 1,300Mbps 802.11ac router — it's considerably less-expensive than almost any other router of similar spec, with three antennae each for the 2.4 and 5GHz bands, four Ethernet ports and two USB sockets. The only downside is that the interface is a little bit less polished and user-friendly — but once you have everything set up, this one does the job just fine.

BEST ADSL/VDSL ROUTER
## Netgear Nighthawk X8 D8500
$590 | www.netgear.com.au

It's rare for modem-routers that integrate an ADSL/VDSL modem alongside the 'router' part to offer cutting edge wireless tech, but the D8500 bucks that trend by offering full 4 x 4 MU-MIMO tri-band 802.11ac Wi-Fi, plus six Gigabit Ethernet ports and a standard WAN internet port, so you can keep using this router even if you move onto cable or a more direct form of fibre internet. Its got many easy-to-use setup options, including impressive site-blocking and media-serving capabilities.

BEST BUDGET ADSL/VDSL ROUTER
## ASUS DSL-AC52U
$150 | www.tp-link.com.au

Like the RT-AC88U above, ASUS's DSL-AC52U offers a similar info-packed interface and broad range of software features, but to hit this lower price point, it's had to drop some of the hardware features. That means it only has basic 802.11ac Wi-Fi that runs at a maximum speed of 433Mbps on 5GHz (as compared to up to four times that on more expensive routers), but that should be more than enough if you're only connecting a handful of devices. You still get four Gigabit Ethernet ports, though, and FTTN NBN compatiblity, too.

BEST POWERLINE KIT
## TP-Link TL-PA8010P
$130 | www.tp-link.com.au

Using 2 x 2 MIMO tech and all three power wires to offer speeds of up to 1,200Mbps, this TP-Link kit is about as fast as powerline gear gets. In real-world testing, though, the adaptors managed 221Mbps up and 219Mbps down, but that's faster than any other PowerLine device tested. This set can handle longer ranges more effectively and make a connection in places that lesser devices won't be able to reach. Installation is easy — plug them in and hit the button. While it's a little pricier than some others, it's well worth the extra cost.

BEST OVERALL
## Samsung Galaxy S8
$999 | www.samsung.com/au

While the Samsung Galaxy Note 8 has overtaken it (slightly) in terms of performance and design, the Galaxy S8 is a still a better deal for those interested in acquiring a cutting edge handset. It might lack the Note 8's included S Pen and extra RAM, but you can pick up an S8 for around $500 bucks less than the price of Samsung's latest phablet. And if you still want a bigger phone, the S8+ is also great value.

BEST PHABLET
## Samsung Galaxy Note 8
$1,499 | www.samsung.com/au

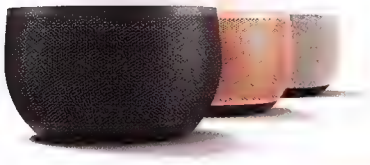
Moving past Samsung's Note-related struggles from last year, the company has returned with what is perhaps the best phablet of all time — the Galaxy Note 8. It's the most powerful phone that the company has ever produced, with 6GB of RAM giving it the processing edge over its S8 range. Samsung's class-leading Infinity Display is better than ever here, and its dual-camera setup is also magnificent for taking professional-looking portrait shots.

BEST BUDGET SMARTPHONE
## Motorola Moto G5 Plus
$399 | www.motorola.com.au

Boasting all the features one expects from a premium handset in 2017, including large internal storage (with room for a microSD card), a slick HD screen, an octa-core processor, fast-charging, 4K video recording and a fingerprint scanner, the Moto G5 Plus is terrific value for money. It's also got a flagship look and feel, meaning you don't have to sacrifice style or functionality. Simply put, the Moto G5 Plus is very impressive for a mid-range phone.

BEST PHONE CAMERA
## Google Pixel 2
From $1,079 | store.google.com

Though dual-camera setups are all the rage these days amongst flagship handsets, you may be surprised to learn that the Google Pixel 2's single lens camera outperformed its competition in the prestigious DxOMark Mobile camera tests, setting a new record in the process. You can thank the phone's ingenious AI and improved camera app for that. On top of this, the Pixel 2 also boasts a slick new design and a water-resistant body.



BEST AI SMART SPEAKER
## Google Home
$199 | store.google.com

It's early days in the Australian AI-speaker scene. The affordable Google Home lets you interact with Google Assistant, as well as control many smarthome appliances, with your voice — so you can say "Add paprika to the shopping list" or "Dim the lights in the lounge room" and it'll comply. It's a neat little digital butler, albeit one with only OK audio output quality. There should be more Home-compatible speakers available by the time you're reading this, and we're planning on doing a round-up early in 2018, so stay tuned.

BEST SMART LIGHTING
## Philips Hue
Starter kits from $70 | www2.meethue.com

For anyone new to the smarthome scene, Philips Hue is a bit of a hard sell. In addition to paying for the smart bulbs, you'll need a $60 Philips Hue bridge to get you started. While this initial investment might seem pricey, it uses a separate local network to communicate, freeing up your Wi-Fi connection and allowing you to daisy-chain to bulbs that your Wi-Fi doesn't reach. The natural-light-alarm settings, light profiles and smart assistant integration is just additional colour for this vibrant offering.

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# TAKE IT VIRTUAL

Alex Cox and Jonni Bidwell strap on the goggles and enter a world where even hardware goes soft.

**Running an operating system on real hardware is so passé. All those hours ensuring your hardware is set up and behaving correctly? Pah. Then so many more hours installing and configuring all the software, so everything's just right, while risking what's on the machine already? Ugh.**

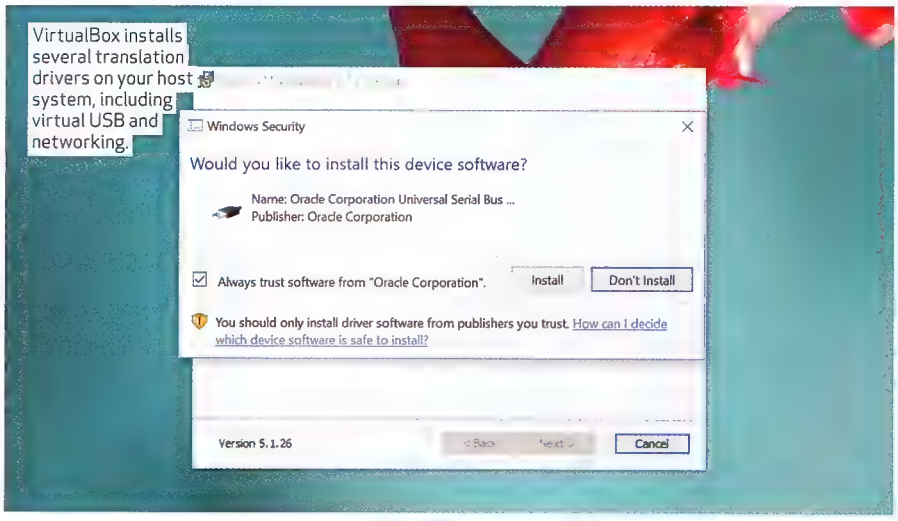
It can seem like an awful lot of effort just to, say, try out a Linux distribution, or create a clean Windows install. And, what's worse, it can present you with a whole lot of extra work if something goes wrong. Killing your day-to-day Windows installation, that one you've spent so long lovingly streamlining and customising, the one you need for work, play and everything else? It doesn't bear thinking about.

If you're running a mission-critical system, you also need to figure out a backup strategy, because mistakes and hardware failure both happen. In fact, if you're serious about these things, you'll really want to have something that's as close as possible to a mirror image of that machine, ready to spring into action at the first hint of failure. Even if you're lucky enough to have an identical machine, maintaining such a thing – updates, drivers, software and all – is monumentally tricky.

Contrast this with a virtual machine (VM). With a VM, you don't have to worry about setting up hardware – any hypervisor worth its salt translates whatever machine it's running on into virtual hardware that your OS can easily understand.

You still have to set up the software side of things, but once done, you can replicate the machine at the press of a button, keeping a safe, clean copy for when you need it. You can test out changes by taking a snapshot of the machine and doing your changes there. If the copied VM survives, its parent will, too, as they're identical. However you use your PC, the chances are there's something to be gained from virtualisation.

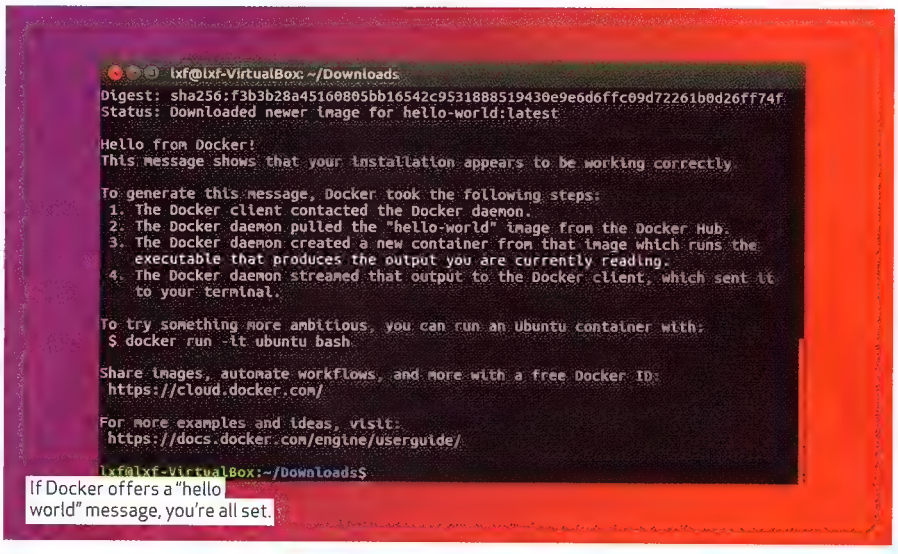
Let's start at the beginning: The easiest way to get into virtualisation is with Oracle's VirtualBox. It's free, open source (barring some extensions that provide USB passthrough), and has a friendly and simple GUI that enables you to set up a virtual machine in just a few clicks. Whether you want to set up a Windows XP VM to practice your hacking skills, fancy trying out a new Linux distro, or even if you want to install something far more weird and wonderful, it's easy and intuitive with VirtualBox. Head to **www.virtualbox.org** to download the latest version for Windows hosts, and install it on your PC. We're using the latest release of Ubuntu Desktop (download it from **www.ubuntu.com/download**) to create an example VM, but feel free to download or use any other ISO you may have lying around.


Windows Security
Would you like to install this device software?
Name: Oracle Corporation Universal Serial Bus ...
Publisher: Oracle Corporation
Always trust software from "Oracle Corporation".
Install
Don't Install
You should only install driver software from publishers you trust. How can I decide which device software is safe to install?
Version 5.1.26
Cancel
VirtualBox installs several translation drivers on your host system, including virtual USB and networking.

## GENESIS OF A VM

Start VirtualBox and click the New button at the left of the toolbar. Give your nascent VM a helpful or affectionate name – if you name it something like 'Ubuntu-VM', the software even automatically adjusts the Type and Version settings below, as well as allocating your VM what it considers a reasonable amount of memory on the next page. You can adjust this yourself, but don't go crazy; the more RAM you give over to your guest system, the less the host has to work with.

The next step is to create a virtual hard disk, which is a file that will

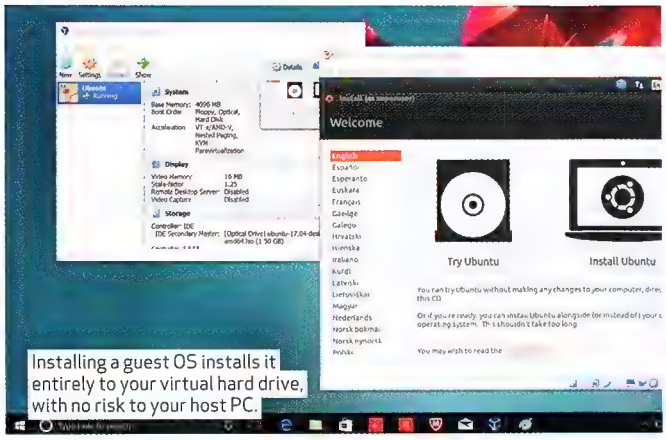

lxf@lxf-VirtualBox: ~/Downloads
Digest: sha256:f3b3b28a45160805bb16542c9531888519430e9e6d6ffc09d72261b0d26ff74f
Status: Downloaded newer image for hello-world:latest
Hello from Docker!
This message shows that your installation appears to be working correctly.
To generate this message, Docker took the following steps:
1. The Docker client contacted the Docker daemon.
2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
3. The Docker daemon created a new container from that image which runs the executable that produces the output you are currently reading.
4. The Docker daemon streamed that output to the Docker client, which sent it to your terminal.
To try something more ambitious, you can run an Ubuntu container with:
$ docker run -it ubuntu bash
Share images, automate workflows, and more with a free Docker ID:
https://cloud.docker.com/
For more examples and ideas, visit:
https://docs.docker.com/engine/userguide/
lxf@lxf-VirtualBox:~/Downloads$
If Docker offers a "hello world" message, you're all set.

## PCI Pass-through problems

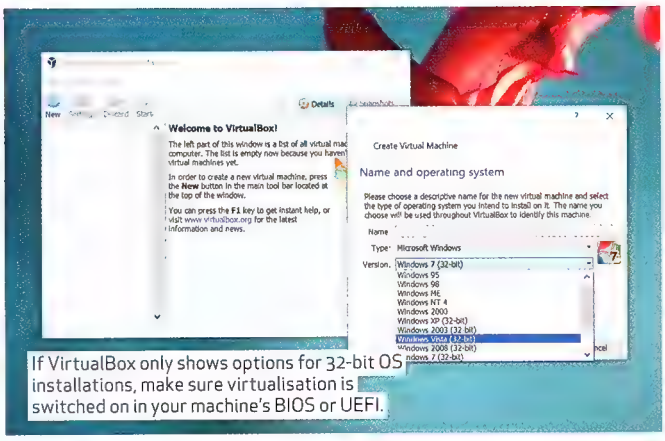
Try to run games or anything else that places any heavy graphical demands on a VirtualBox VM, and you won't have much luck. VirtualBox's 3D acceleration doesn't really do anything for DirectX 10, 11 or 12 titles. There is a solution, but it's one with some pretty heavy requirements. You need to run a Linux distribution as your host OS, and have two graphics cards in your physical machine, one of which you'll use for your host — integrated graphics will do — and the other you'll dedicate entirely to your VM. You also need to have a motherboard with an IOMMU unit, a CPU that supports it, and IOMMU enabled in the BIOS or UEFI. IOMMU is essentially a translation methodology, which maps physical memory addresses between guests and hosts — on AMD machines, you need to look for AMD-Vi, and on Intel, it's Intel Virtualization Technology for Directed I/O, or VT-d. These aren't unusual features for modern boards, but we recommend you check compatibility before you kill off your everyday OS in favour of a Linux host.

From there, it's a not-so-simple process of installing VirtualBox on your host OS (after ensuring it's running a kernel that's IOMMU-compatible), adding in the PCI passthrough extension through the catch-all extension pack, which can be downloaded from **www.virtualbox.org**, enabling IOMMU in your Linux distro's boot loader (add something such as `intel_iommu=on` to grub.cfg), then using the 'lspci' command to check which PCI devices you have attached to your host hardware. The first column lists the PCI address of each device; you can then run a terminal command along the lines of `VBoxManage modifyvm "VM name" --pciattach 02:00.0@01:05.0` to pass, in this case, the device at host address 02:00.0 to the guest address 01:05.0. Complex stuff, but entirely possible if you're determined.

Want to use your GPU to its full effect with a VM? Pass it through....



Installing a guest OS installs it entirely to your virtual hard drive, with no risk to your host PC.



If VirtualBox only shows options for 32-bit OS installations, make sure virtualisation is switched on in your machine's BIOS or UEFI.

**"Make sure you set the top limit of your virtual drive to at least 16GB, or more if you can spare the bytes."**

house our VM's data. Choose Create, and select the default VDI image. In the next step, choose to make it Dynamically Allocated. This means the file grows as the virtual disk fills, rather than being a big, mostly empty file from the get-go. There's a small performance penalty for this luxury, so you may wish to opt for the more inflexible fixed size option if speed is a big concern; a plain desktop Ubuntu install, for example, occupies less than 4GB, but OSes have a habit of growing over time, and a Windows 10 install would take a lot more space. Make sure you set the top limit of your virtual drive to at least 16GB, or more if you can spare the bytes.

## GET UP AND RUNNING

That's it – machine built. You have a VM. But try booting it, and you won't get far, since its drive is currently completely blank. Let's insert a virtual disc and get something installed. Select the machine and click Settings on the toolbar. Go to Storage on the left, and you'll see that a virtual optical drive (attached to a virtual IDE controller) has been set up, as well as our virtual hard disk. Click this, then press the disc icon on the right-hand side, and select 'Choose Virtual Optical Disk File' from the drop-down menu. Select your downloaded Ubuntu ISO.

Now let's offer up some additional resources. In the 'Settings > Display' section of the Screen tab, boost the Video Memory to 128MB. Click OK, and launch your VM by selecting it and clicking Start. You're now free to install, or play in the Ubuntu live environment, whatever you like, in complete safety – there's no way of doing damage to your main PC, as you're operating in a completely isolated environment. Don't worry about installation specifics – if you decide you want something done differently, it's easy to delete the VM and start over. When the install finishes, the virtual disc is automatically ejected.

One final step to getting things working well. Use the Devices menu to insert VirtualBox's guest additions disc into your virtual optical drive, and install the software within. Obviously, this only works for supported guest platforms, but once it's installed, you gain access to neat features such as a shared clipboard and custom dynamic resizing options. You can also, once you head to the Display section of your VM's settings, switch on 3D acceleration. It isn't the best – see 'PCI Pass-Through Problems' to find out why – but it's a much more pleasant experience than running without it.

## SAFETY IN SNAPSHOTS

As we've mentioned, the greatest part about running a VM is the control it gives you over the OS – specifically, the fact that, once you've done the hard work of setting one up, you'll never have to do it again. You'll want to use two techniques: wholesale copying of a VM, and snapshotting. The former is reasonably easy. Just right-click a powered-down VM, and select Clone. VirtualBox creates an exact copy of that VM, which you're free to monkey around with to your heart's content, or set aside for later recovery. A snapshot is slightly different and arguably slightly more useful. It's an exact copy of a running VM, memory state and all, giving you the chance to revert back to a known good configuration if you're about to do something drastic, or to power down your virtual machine and return to the exact point you were at before you quit.

VirtualBox can even handle snapshots in a tree, so you can create several snapshots, fork off in different directions, and keep the same core configuration. You can take a new snapshot at any time by hitting Host-T (your Host key is usually right-Alt), and you're given the option of creating one when you power down a VM as well. These do tend to swallow up hard drive space after a while, so be prepared for a bit of periodic cleanup.

## GO SELF-CONTAINED

Let's take a step back now. For all the benefits they offer, every new VM spun up means a new copy of an operating system. This means lots of duplication of data and effort. A virtual OS still takes time to install, and even though this can be automated to some extent, most VMs still take some configuring before they're useful. And if you're using a VM for a single task, this is, frankly, a bit of a waste of time and system resources. But there's a more streamlined way of isolating apps and services, without installing a whole new OS, enabled by the idea of containers. These give some access to the host OS, but drastically restrict access to anything that might break it, and enable applications to be deployed in a uniform way on any OS. Any sysadmin who's had to migrate an old webapp to new infrastructure will know the special sort of pain this can avoid.

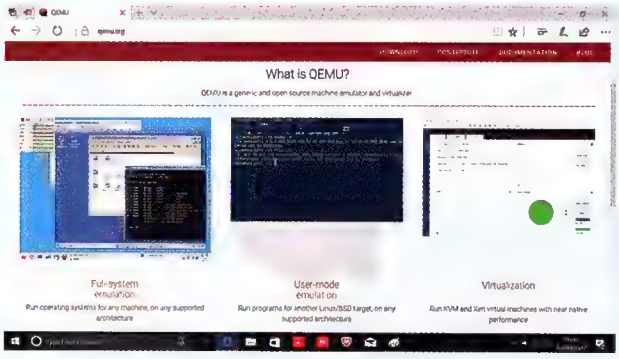
The de facto king of container management, widely used and therefore widely supported, is Docker. Thanks to the Docker Hub, it's possible to download a community-generated image of an email server, a NextCloud instance, a NAS appliance, or an MPD server, say, and have it running in a matter of seconds. Docker's Community Edition (the one we're using here) is freely downloadable, and available for Windows 10 Pro and just about every Linux distro – but bear in mind that this means it's not compatible with Windows 10 Home, the version most people are running.

## Going beyond VirtualBox

We've covered VirtualBox in detail, primarily because it's free to use and pretty comprehensive in its abilities. For most tasks, you're unlikely to need anything more complex.

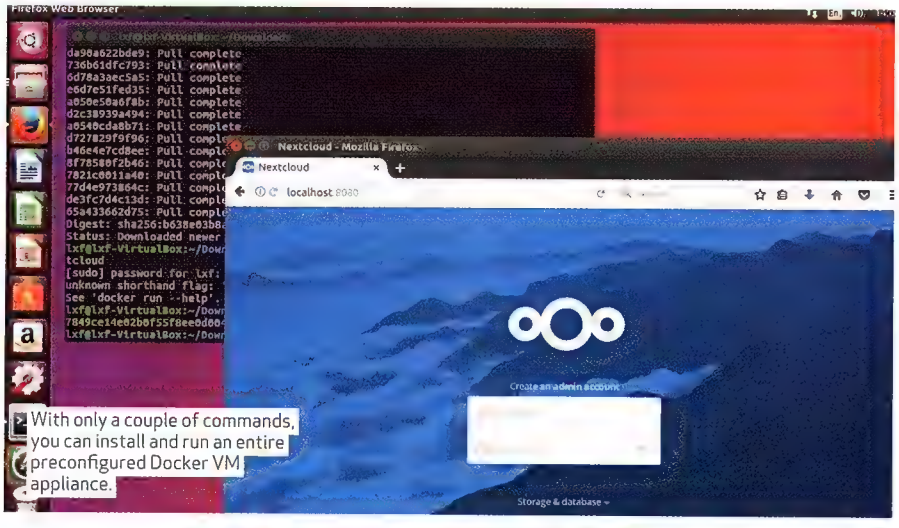
If you want to take virtualisation further, though, there are a few commercial tools that can make the process easier and (generally) run VMs more efficiently. VMWare Workstation Player, free with a limited set of features, is a solid option, and one that's compatible with the same VHDs, though you need to pay a licence fee if you want to use it commercially. Its level of support and development is, naturally, very good — it's arguably more capable than VirtualBox, and it's due a major version upgrade soon, which should add a little spice. Check it out at **www.vmware.com**.

If you're willing to create a dedicated host, it's also worth considering Linux-based solutions. QEMU (**www.qemu.org**) is available for just about every Linux distribution, and it's super-efficient, executing as much of the guest code as it can directly on the host machine, through a process known as dynamic binary translation. It's also able to run without admin privileges, meaning you can tuck your QEMU VMs away on a flash drive, carry them around with you, and return to a familiar environment no matter which host machine you're running on. There's a version compiled for Windows, if you're

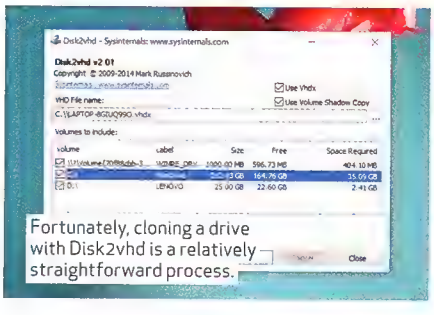



feeling adventurous — see **http://qemu.weilnetz.de** for the downloads.

While we're in the Linux world, picking a distro based on the Xen hypervisor is a good choice for experimentation. Check out Qubes OS (**www.qubes-os.org**), which dubs itself "a reasonably secure operating system" with a typical lack of hubris. All of its apps run in one of a number of VMs, isolating them from the others for security and efficiency reasons, and you can add your own VMs — including those based on a number of different Linux architectures and, naturally, virtual machines based on Windows.




With only a couple of commands, you can install and run an entire preconfigured Docker VM appliance.




Fortunately, cloning a drive with Disk2vhd is a relatively straightforward process.

With this in mind, we'll show you how to use its Linux flavor through Ubuntu — simply download and install the Community Edition from **www.docker.com/get-docker**, then replicate the commands here, cutting out the "sudo" parts, in a Windows PowerShell window, and you shouldn't run into too many problems.

### DOCKING FOR BEGINNERS

Let's start by installing Docker on Ubuntu. While it's possible to install through a command-line package manager, setting up the requisite repositories is a little long-winded. Instead, head to **download.docker.com/linux/ubuntu/dists** and grab the latest stable version for your system — you'll find a .deb package within the requisite /pool/ folder. Download it, rather than open it in Ubuntu's software installer.

Open a Terminal window, and head to the directory where you downloaded the package (typically ~/Downloads). Type `sudo dpkg -i docker` then, before hitting Return, hit Tab to complete the name of the package you just downloaded. Hit Return, and the installation should happen.

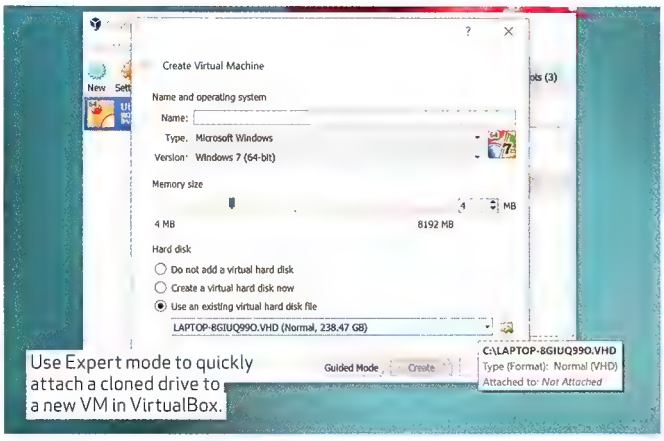
Let's check that it did. Fire up the Docker daemon with `sudo systemctl start docker`, then run `sudo docker run hello-world`. All being well, this pulls in a sample script and executes it — if you see a cheery message, you're good to go.

Time to install something that does more than just display a message. Run `sudo docker pull nextcloud` to grab a container encapsulating everything required to run a NextCloud file server. At 700MB, it's fairly large, but bear in mind the NextCloud app is 100MB, plus we've got Apache, PHP 7 and a bunch of extensions, along with the SQLite database packaged in with it, all ready to go.

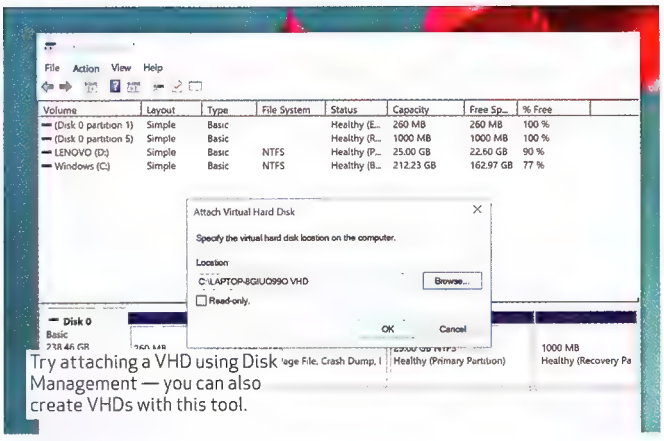
Run the container with `sudo docker run -d -name maxcloud -p 8080:80 nextcloud`. The '-d' option tells Docker to run in the background (detached), and the '-p' part forwards port 80 on the container to port 8080 on our host. The '-name' part is optional; a random one is assigned if you don't specify one here.

Assuming that command didn't give you any error messages, fire up your web browser, and browse to **http://localhost:8080**. Behold! A fully functioning NextCloud installation — no messing with Apache configuration files or directory permissions, it just works.

All you need to do is enter some admin credentials and click 'Finish Setup'. When you stop the container with `sudo docker stop maxcloud`, any changes are saved, unless the underlying image is upgraded, so you can resume it as it was with `sudo docker start maxcloud` in future.



Use Expert mode to quickly attach a cloned drive to a new VM in VirtualBox.



Try attaching a VHD using Disk Management — you can also create VHDs with this tool.

Note: We use our container name, rather than the image name (nextcloud), because the latter would fire off a new, unconfigured NextCloud instance.

## PHYSICAL TO VIRTUAL

As you've got this far, you're probably starting to appreciate the value there is in virtualisation. But there's one more thing we haven't touched upon, and that's consolidation.

One machine with a number of virtualised instances running on it can do the job of several physical units without the need for any extra hardware. If you're in the mood to replace that old file server and trash that Win XP box that really should have been recycled 10 years back, there's good news: you don't need to completely rebuild those systems in a virtual environment. You can convert their hard drives to virtual drives, and fire them up in VirtualBox as though they were newly created VMs.

Note that this does come with a couple of downsides, namely that Windows may need a little poking before it accepts your new virtual hardware, and that you'll almost certainly invoke a new activation of your Windows key when you fire up its virtual version — major hardware changes tend to do that, so you need to erase the old hardware, and perhaps contact Microsoft to arrange reactivation.

Note also that transferring an OEM installation of Windows to a virtual instance is a violation of the terms and conditions of installation, so you're unlikely to get much assistance in this case.

To convert an existing installation, we recommend using Disk2VHD, a tool from Microsoft's Sysinternals team. The process is really pretty simple. Download Disk2VHD from **bit.ly/2wlLzb4** and run it. Define the file name you want to give to your virtual drive, and pick the volumes you want to clone. Disk2VHD leaves your partition tables intact, but you can exclude the data of certain partitions if you want to keep the size down.

Switch off VHDX, hit Create, and Disk2VHD uses Windows' own Volume Snapshot tools to create a byte-by-byte copy of your chosen drive.

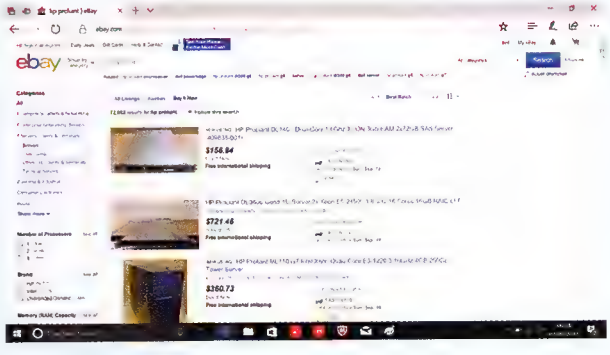
When it's done, fire up VirtualBox, make yourself a new VM with the appropriate parameters for your cloned OS, then enter Expert mode, and select your .vhd file in the bottom box. Boot, and you'll be away — don't forget to install the Guest Additions for the best experience.

Oh, and one more thing! Did you know you can mount VHD files natively in Windows using the Disk Management tool? There's something to try... ■

## Serious virtual machines

If you begin to rely on virtual machines to a serious extent, enterprise-grade solutions are probably worth a look. The industry standard for virtualised servers is VMWare's ESXi tech — available free in a package called vSphere Hypervisor — and Microsoft also offers up its Hyper-V Server 2016 without charge. Both solutions run a similar model: a complete hypervisor running at the OS level, and nothing else. In the terms we've used in this feature, they're your host operating systems, but they do nothing more than host, giving their guests unprecedented access to system hardware, and giving you high-level access to the administrative tools you need to maintain a server full of temperamental yet critical systems. Typically, home users boot the likes of ESXi from a small local drive, such as a USB stick or an SD card, with VMs stored on mass storage devices elsewhere.

As you might expect, running server-class software generally requires running server-class hardware to match. Of course, you're free to install vSphere Hypervisor on a USB stick and attempt to run it on hardware you may have on hand, and we've certainly heard tales of it working, though this isn't incredibly likely, unfortunately. Luckily, the unstoppable march of progress means that businesses are




constantly upgrading their equipment, meaning you can often grab suitable rack-mount hardware for a fraction of its original cost if you shop around. Naturally, your power bill will rise, they're noisy and hot as all hell, and you'll need somewhere to put it, but a dual-CPU Xeon system, packed with RAM, could cost as little as $300 if you're lucky enough to find one locally. Check the compatibility list at **www.vmware.com/resources/compatibility** to see whether you're likely to be able to easily fire up a set of VMs — and then check your wallet, because playing home sysadmin can be an expensive hobby.

# how to

» QUICK TIPS

# Experts solve your computing problems

**APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.**

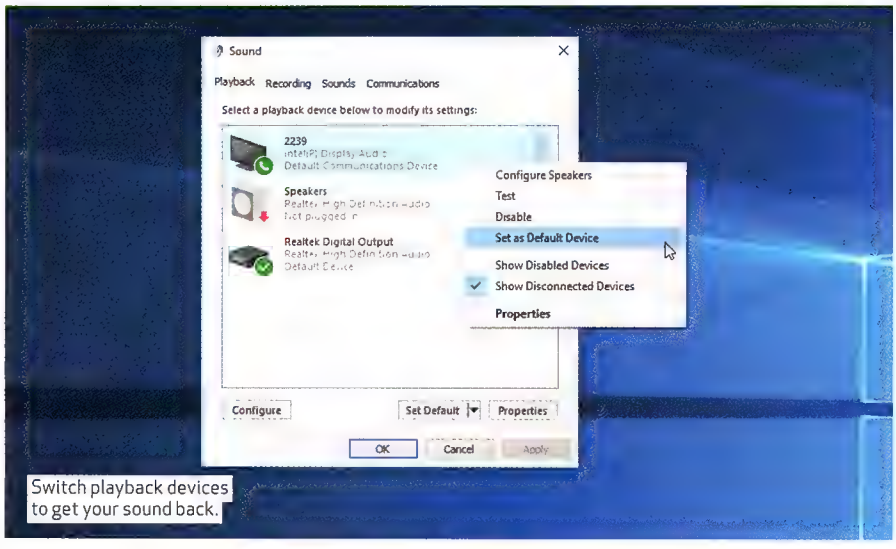
HARDWARE

## WHY AM I GETTING PICTURES, NOT SOUND?

***Recently, I connected my laptop to the television via HDMI to watch something on the big screen, but can only get pictures — not sound. Everything was fine up until this point — I'm running Windows 10 on a HP laptop and have verified that the HDMI cable is working correctly.***
Andrea Christou

These days, both laptop and desktop PCs offer multiple sound outputs, and if you have the wrong one selected as the default, it means you can appear to lose all sound. To solve this problem, start by clicking the ^ button in the Taskbar Notification area. Look for a white volume icon, right-click it and then choose 'Playback devices'. One will clearly be marked as the default – our guess is that it's not the correct one, so right-click each device in turn and choose Test. When you hear sound again, select the device in question and then click 'Set Default' to make it the default from now on.

Going forward, when you connect your HDMI cable between your laptop and your TV again, you may need to return here and switch the sound output to the HDMI port temporarily to hear sounds coming through your television.
Rob Mead-Green



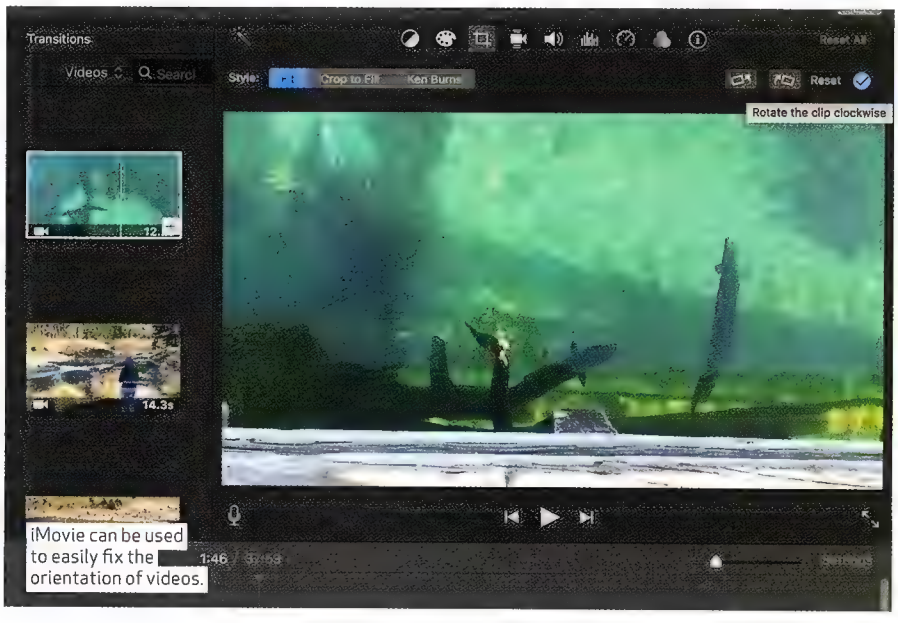
Switch playback devices to get your sound back.

MAC

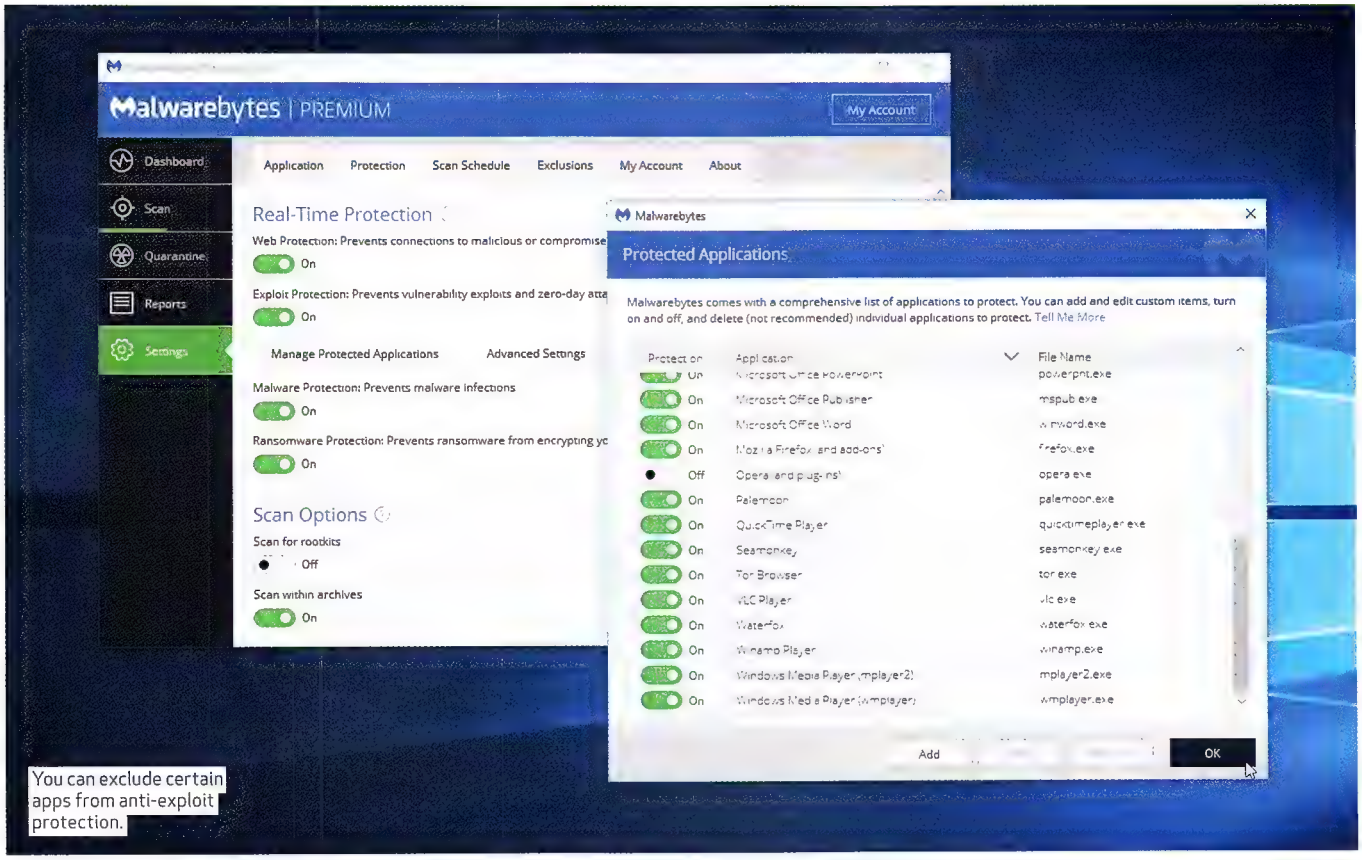
## IPHONE VIDEO SHOOTING WOES

***I recently went on a holiday to the South Island of New Zealand (I know, lucky me) and was taking some videos of some eels from a little pier. I religiously shoot in landscape, so imagine my confusion, then, when I came home and watched the video again in iMovie on my Mac and saw that it had been captured in portrait mode! How can I rotate the video so that it plays the way I intended without cropping or losing quality? I'm making a home video to send to my family overseas.***
Linda Bannister

Indeed, lucky you! There are a few ways to do this, depending on your situation. You mentioned making a home movie. Well, in that case, you're already in the right place. Go back to iMovie on your Mac and select the video in question. (Note, if you have already started a project and have added the video into the timeline down the bottom, then select it from there instead of from My Media.) Above the video preview are a row of options. Click the Crop button. On the top right should be a couple of rotate options next to Reset. Here, you can realign your video to how it was meant to be captured and go on your merry way! This, however, doesn't change the alignment of the original file, so if you do want to make those changes permanent, open up the video separately from your Project, make your changes, then hit Export and save it as a new



iMovie can be used to easily fix the orientation of videos.



You can exclude certain apps from anti-exploit protection.

file to your computer. If you have the iMovie app on your iPhone, you can actually rotate it directly through there and then save the edited video to your Camera Roll. Alternatively, there are other third-party apps that can do that for you, as well, such as VideoRotate or Rotate & Flip. So all is not lost!
**Carmel Sealey**

## INTERNET
## GREY SCREEN IN WEB BROWSER

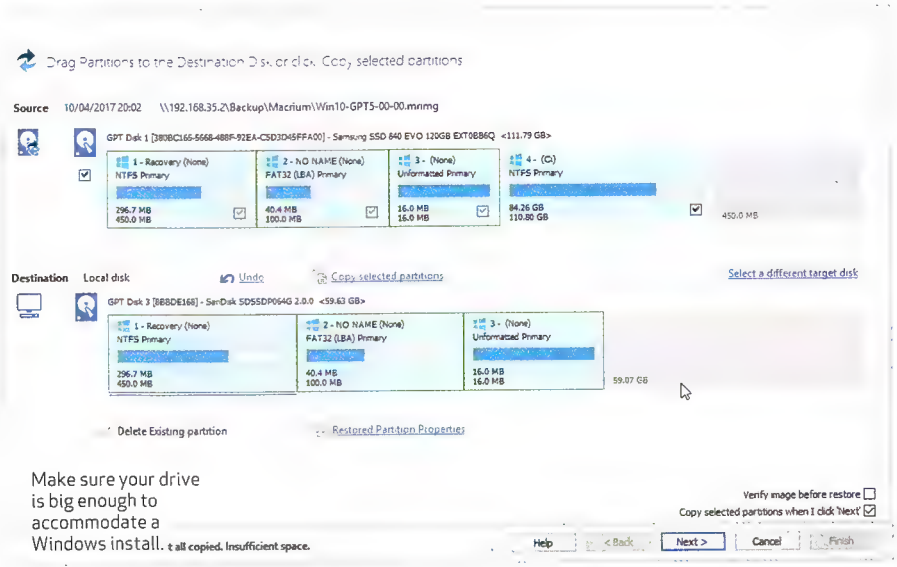
***Every time I launch Opera, it opens to a grey screen. And if I open Chrome, I get the same grey screen plus a list of messages about add-ons crashing on startup. I can't access settings, extensions or find any way to relaunch either with extensions disabled. What can I do?***
**Bill Graham**

We traced Bill's problem to the Chromium sandbox, which is present in both Chrome and Opera. Pressing Windows-R and typing `chrome -no-sandbox` or `opera -no-sandbox` enabled us to launch a working version of either browser (Chrome warned us about the flag we'd invoked, while Opera simply functioned as normal).

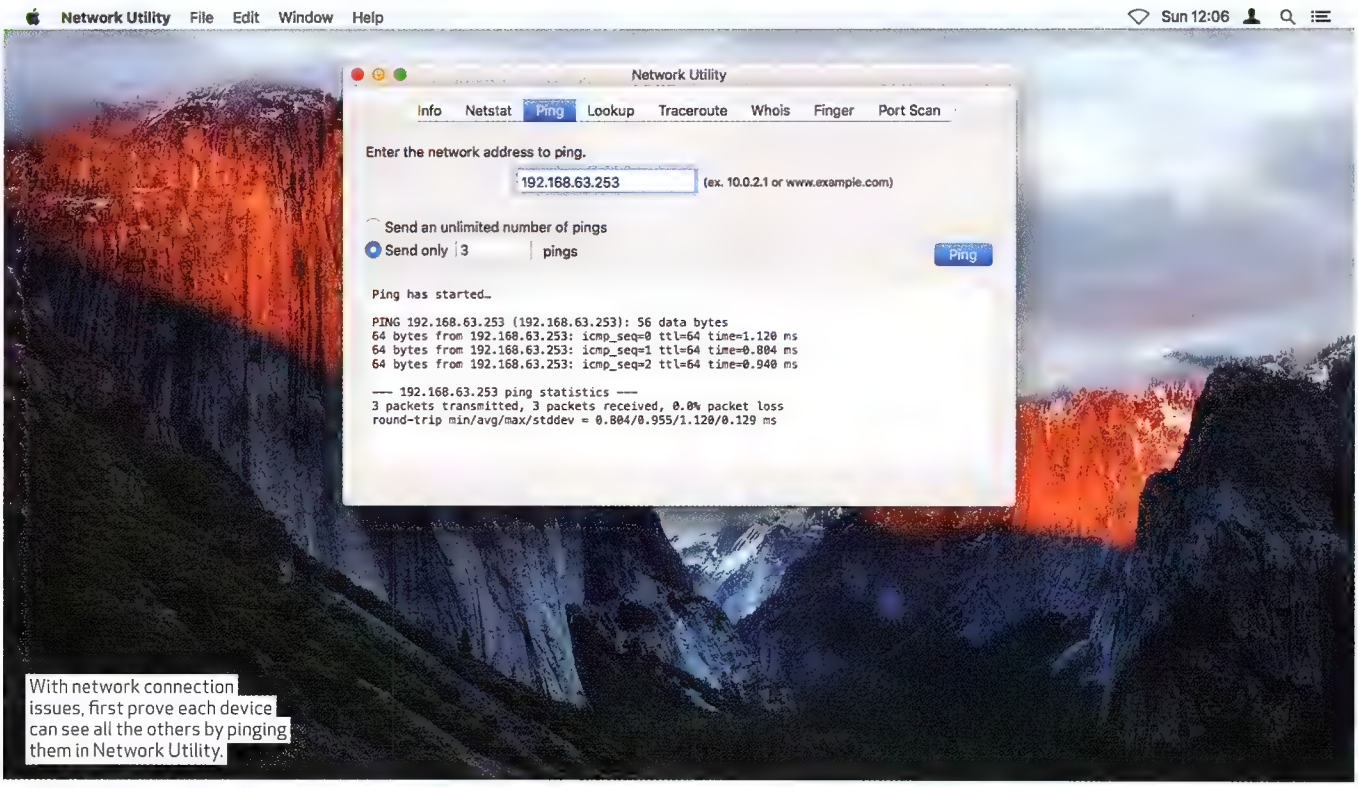
Most sandbox-related problems are often traced back to security software. Bill was running Norton Internet Security and Malwarebytes Premium. We instructed him to temporarily disable Norton's auto-protect feature, to no effect, but after he'd disabled all four layers of Malwarebyte's real-time protection, Bill's browser problem disappeared. He then re-enabled them one at a time, and the problem resurfaced only when Malwarebytes' Exploit Protection module was switched back on.

**"If you have the iMovie app on your iPhone, you can actually rotate it directly through there and then save the edited video to your Camera Roll."**

We checked the Malwarebytes forums (**forums.malwarebytes.com**) where a number of other users reported the same problem. This is likely to be resolved in a future fix, but for a temporary workaround, switch



Make sure your drive is big enough to accommodate a Windows install.


Network Utility File Edit Window Help
Sun 12:06
Network Utility
Info Netstat Ping Lookup Traceroute Whois Finger Port Scan
Enter the network address to ping.
192.168.63.253
(ex. 10.0.2.1 or www.example.com)
Send an unlimited number of pings
Send only 3 pings
Ping
Ping has started…
PING 192.168.63.253 (192.168.63.253): 56 data bytes
64 bytes from 192.168.63.253: icmp_seq=0 ttl=64 time=1.120 ms
64 bytes from 192.168.63.253: icmp_seq=1 ttl=64 time=0.804 ms
64 bytes from 192.168.63.253: icmp_seq=2 ttl=64 time=0.940 ms
--- 192.168.63.253 ping statistics ---
3 packets transmitted, 3 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 0.804/0.955/1.120/0.129 ms

With network connection issues, first prove each device can see all the others by pinging them in Network Utility.

"When you come to restore the image, Macrium should detect that your new SSD drive is probably smaller than your old hard drive and offer to resize the partitions during the restore process."

Exploit Protection back on under 'Settings > Protection', then click 'Manage Protected Applications' to disable Exploit Protection for both Opera and Chrome, both of which should be listed. This will allow you to run them with the sandboxing features enabled.
**Nick Peers**

## HARDWARE
## MIGRATING TO A NEW SOLID-STATE DRIVE

***I'm planning to buy a solid-state drive and want to know if I can migrate my existing Windows system drive to the new drive using Macrium Reflect Free in conjunction with a rescue disc. I'm thinking of imaging the Windows system drive to DVD.***
**Peter Claxton**

While it's possible to do what you want using DVDs, we don't recommend it, Peter. The size of your Windows system drive means a minimum of four discs – and probably many more – will be required. Furthermore, it's a slow process and you'll need to be on hand to swap out the discs. Instead, back up to an external hard drive or large (64GB or 128GB) flash drive following the guide at **www.techradar.com/1319885**. Once backed up and verified, swap out your old hard drive for your new one. Then boot from the Macrium rescue media and choose the Restore option. If your image isn't detected, click 'Browse for an image file' to manually select it. When you come to restore the image, Macrium should detect that your new SSD drive is probably smaller than your old hard drive and offer to resize the partitions during the restore process. Some further considerations: make sure that your SSD drive is large enough to comfortably accommodate your current C drive, and be sure to choose the option to image all the partitions required to back up and restore Windows. We usually recommend you hive off your data to a separate drive when upgrading to an SSD to give Windows room to breathe.
**Nick Odantzis**

## MAC
## SHARING BETWEEN SNOW LEOPARD AND EL CAPITAN

***Although both my iMac and MacBook Air run El Capitan and share via Wi-Fi, my wife's Mac mini is still on OS X 10.6.8. We can't establish a network connection between her mini and either of my Macs. Is that possible?***
**Alan Derkacs**

It's often tricky to share access across such a range of OS X versions. It may be easier to connect the more recent version to the older one, rather than the other way around. If you can upgrade the mini to run El Capitan, too, you should be able to connect either way. Debugging networks starts by setting all your devices to use fixed IP addresses (such as 192.168.1.1, 192.168.1.2 and so on) on the same subnet.
Open Network Utility on each – enter its name in Spotlight to find it – and select its Ping tab. Prove connections between the various Macs are possible by pinging each Mac's IP address from all your other Macs. Next, turn on file sharing, ensuring that a useful folder, such as Documents, is being shared.
In Finder, choose 'Go > Connect to Server', and in the dialog that opens, enter the IP address of the other Mac. Enter the admin user name and password for the other Mac that you're trying to connect to, not the one you're connecting from.
**Ian Sleightholm**

INTERNET

## STOP INTERNET HOGS

***One of my children is constantly downloading and uploading to the detriment of the rest of our household. What steps can I take to apply limits so the rest of us get a reasonable speedy internet connection?***
Xavier Rodgers

If the problem is linked to a specific app or program, and your child cooperates, check its settings for an option to limit upload and download speeds – try the automatic setting if it exists, otherwise check your router for your upload and download speeds and set limits accordingly – say 50% of the total available bandwidth.

If they refuse to help, log into your router's configuration utility in your web browser and see if you can find a Bandwidth Control or QoS section. Options vary according to your router, but you should be able to create rules for your child's specific IP address, then either set specific limits in Kbps or look for a Priority setting. This would enable the child to upload and download with no limits until other devices come online, at which point, their web demands would take precedence. Consult your router's manual o r support website for specific instructions.
**Matt Hanson**

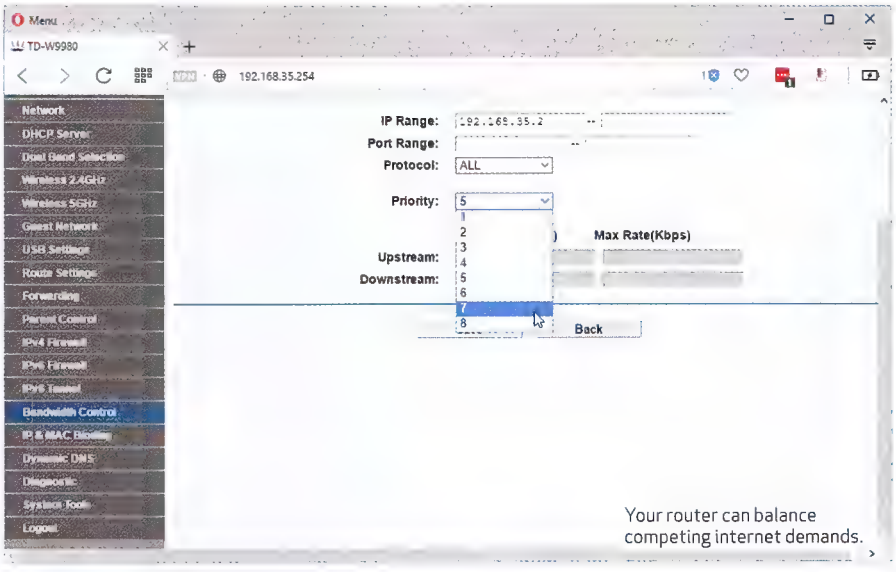
HARDWARE

## FASTER OR SHARED STORAGE, BUT NOT BOTH

***I create and edit architectural files typically of 25MB or larger, and am a keen photographer with a large Photos library. The former files are stored on a WD MyCloud Mirror so I can access them from other systems, but they take a long time to save. My Photos library is eating space on my laptop's internal 512GB SSD. How can I reduce the time it takes to save files and keep my photos to hand?***
Richard Jagger

A faster hardware-based RAID NAS would improve performance a bit, but you would need to go up to much more expensive network systems to match the performance of internal storage. Your fastest option would be to fit a larger internal SSD, but architectural files stored there would need to be synchronised over your network to the NAS or other shared storage; you could do that using a folder-syncing app, perhaps.

An SSD or even a hard drive in a Thunderbolt enclosure would also perform very well, although again you'd need to synchronise over your network. USB 3.0 models are often significantly cheaper. For your Photos library, a cost-effective and neat answer might be to add a fast 128GB or larger card to an SDXC card-reader (which will cost upwards of $100). Otherwise, keeping it on an external drive would mean the library would only be accessible while that drive is connected to your laptop.
**Ian Sleightholm**



Your router can balance competing internet demands.

EMAIL

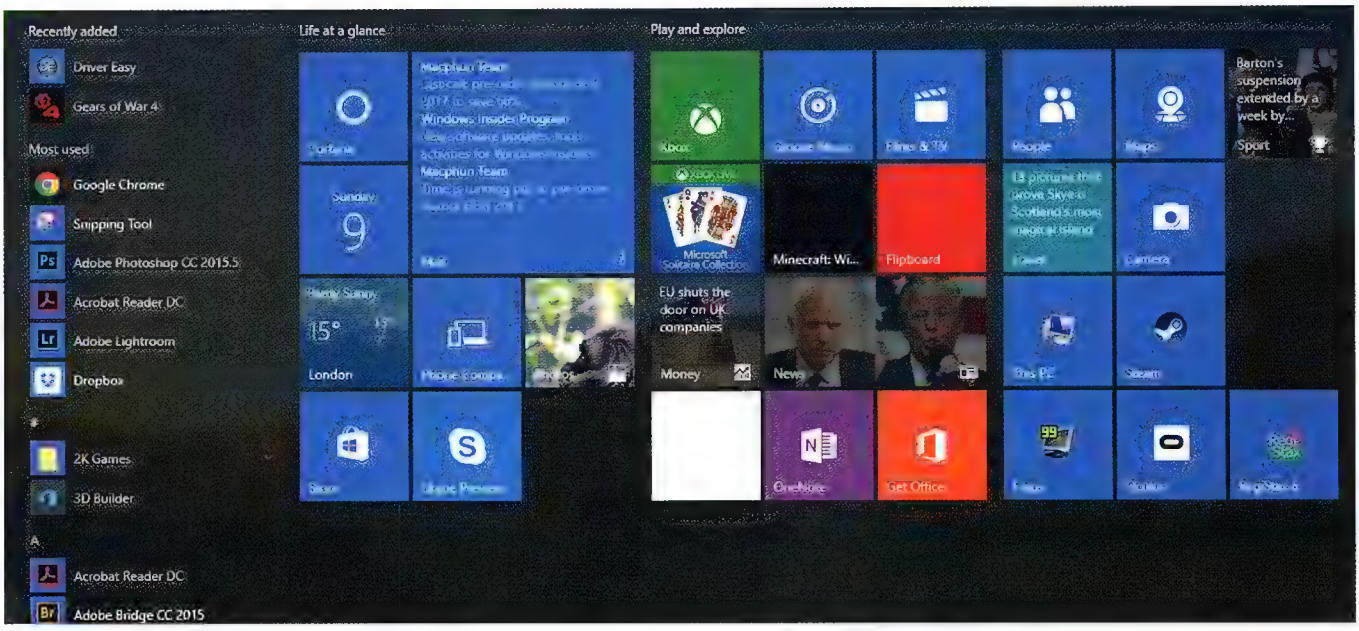
## QUICKLY REDRAFT AN EMAIL

***Occasionally, when I send an email, it's not sent because I misspelled the recipient's email address. Is there any easy way to correct this without having to rewrite the whole email again?***
Jim Duncan

The quickest thing to do is locate the email in your Sent folder, then open it and click the Forward button. Remove the email header information from the body of the email itself, and amend the subject line to remove any reference to forwarding (typically 'Fwd:'). Then it's simply a case of entering the correct address and hitting Send again.

Going forward, try to make use of your email program's contacts – Jim's a Gmail user, so when he starts typing a name or email address, a list of previously entered addresses (and stored contacts) should appear.
**Cat Ellis**

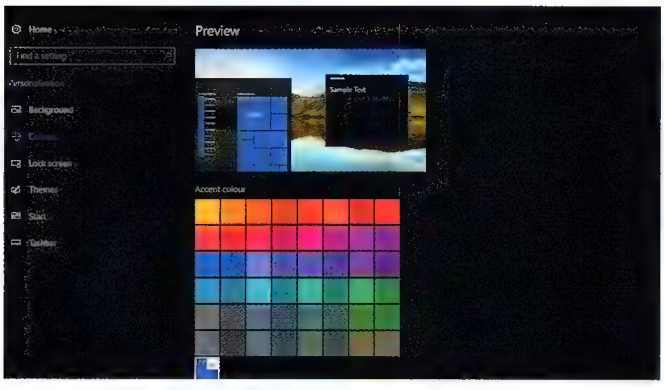
It's easy to forget that the SDXC slot in a MacBook Pro can be used to conveniently boost storage capacity.




# Customise the Windows 10 Start menu

## The Start menu in Windows 10 is more powerful than ever — here are some easy tips to make it work for you.

The Start menu's return was big news when Windows 10 launched, and it has evolved as the operating system has been updated. It's become a fast and efficient way to access apps and settings – Windows 8's full-screen monstrosity is now a distant memory, thankfully! However, if you don't like how the Start menu looks when you first pop it up on your fresh install of Windows 10, it doesn't have to stay that way. It's fully customisable in ways that were never possible in earlier versions of the operating system, and can be made to work in just about any way you want, standing out from its background for ease of reading, or automatically blending in with the colour scheme of whatever theme you have currently set on your desktop.

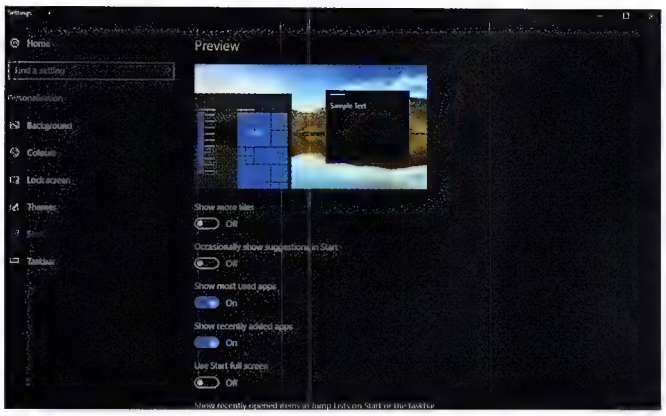


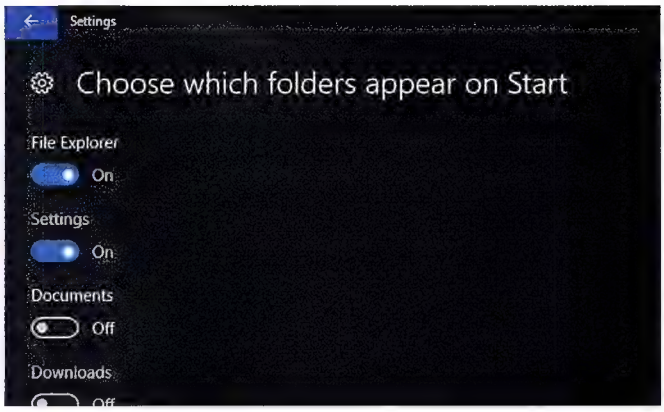
### 1 COLOUR

Your Start menu's background can be any colour you like — all you have to do is untick a box. Open up Settings, then Personalisation and finally Colours. Untick the 'Automatically pick an accent colour from my background' option and you'll be able to pick a colour from the palette. So your Start menu can be a contrasting red or yellow rather than a dull blue or grey. Play around to find a combination that works for you.

### 2 SIZE

To make space for all the customising you can do to the Start menu, you can easily resize it to your liking. Just move your mouse pointer to the top-border or right-border of the Start Menu, the pointer will change into arrows, and you'll be able to increase or decrease height and width, dragging it out to completely fill the screen if you want to. This is particularly useful if you have a PC filled with programs that you access regularly.



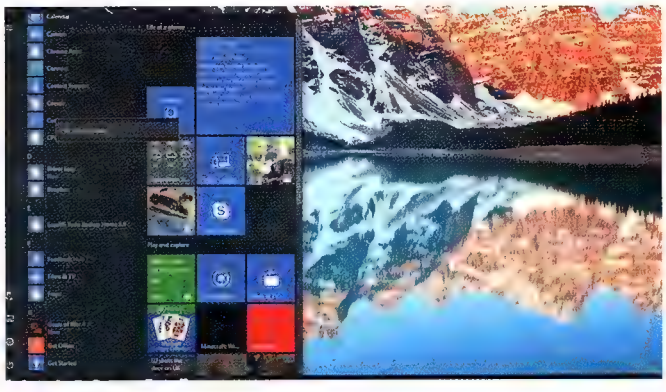




## 3 FOLDERS AND TILES

Your Start menu is made up of lists and tiles, and some of these can be shortcuts to folders such as Documents. 'Settings > Personalisation > Start' enables you to tinker with this, so if you never shoot videos, you can stop the empty Videos folder from taking up space on the menu. You can turn the links to the Settings window, and the one that opens an empty File Explorer window, on and off too.

## 4 HIDE PROGRAM LISTS

By default, the Start menu will show you lists of both your most used programs and the most recently opened ones. This can end up repeating itself, so if you want to get rid of one or the other of the lists, or both, open up 'Settings > Personalisation > Start', from where you'll be able to toggle the lists on or off. You can also prevent apps from appearing on the lists so you only get a view of the things you really need from day to day.

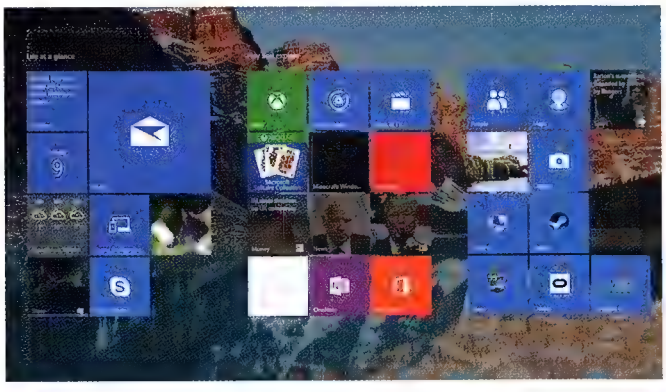


## 5 USE IT TO SEARCH WITH

Hitting the Windows (Win) key on your keyboard to pop up the Start menu's Search box is one of the fastest ways to look for anything in Windows 10. Just type a few characters and you will get suggestions for applications and documents stored on your computer that match your initial query. You can also use the arrow keys on your keyboard to navigate the Start menu, if you'd rather not use the mouse.

## 6 LIVE TILES

Live tiles are tiles that are constantly updated with data, usually gleaned over the internet to make them up-to-date. There's one for the Mail app that shows your most recent messages, one for the Weather app that uses your PC's location to tell you what's going on outside the window, and so on. If you find them distracting, you can turn them off by right-clicking them and choosing the appropriate option.



## 7 PIN TILES AND SHORTCUTS

If there's something you need to be able to find quickly, but which gets lost in the lists of the Start menu, you can pin and reposition it so it's always prominently placed. To do that, right-click an item and choose 'Pin to Start'. It will now appear in tiles. Now click and drag the tile to where to want to move it. To resize the tile, right-click, choose Resize, then the tile size you want. You can pin shortcuts to the Taskbar for easy access too.

## 8 BRING BACK THE START SCREEN

It may have been almost universally mocked and reviled in Windows 8, but the full-screen Start menu is still there in Windows 10, ready to block out all your work at a single press of the Win key! But if you liked it, go to 'Settings > Personalisation > Start' and tick the box marked 'Use full-screen Start when in the desktop'. Note that wording: the Start menu now won't actually cover up your apps like it used to do in Windows 8.

# Recover files on Mac with Time Machine

Alan Stonebridge reveals the power of Time Machine and Versions to recover your files.

**Your Mac comes with a built-in backup system called Time Machine that's very easy to use. It only takes an external drive and a minute or two to get started with, and it then backs up any file changes roughly once an hour. It's easy to overlook some of this feature's capabilities, so this cheat sheet gives an overview of the various ways to recover changed words, files you've trashed by mistake, or even your whole setup if a big problem occurs or you buy a new Mac.**

If you use a portable Mac, you may notice different coloured notches in Time Machine's timeline. Bright red represents local snapshots, which are explained opposite. By upgrading to High Sierra, you stand to benefit from an important improvement to when they are created: your MacBook will create a local snapshot immediately before any update to macOS itself is installed, providing a fallback should something go wrong during the update. Read on for more backup and restoration tips.

## Backing up at multiple locations

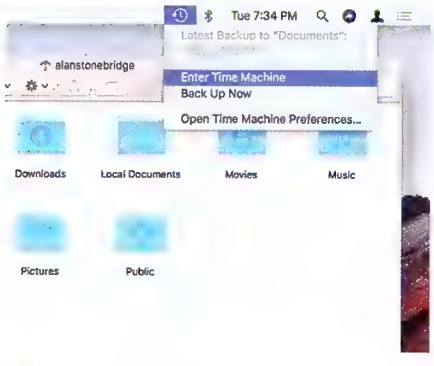
How to use Time Machine at work and home.

If you haven't already set up your first backup disk for use with Time Machine, connect the disk to your Mac; Time Machine will ask whether to use it as a backup disk. If there are files on the drive that you need to keep, copy them elsewhere before responding to the prompt. When you're ready, decide whether to encrypt the disk's contents, then click 'Use as Backup Disk' — you may also be asked whether to reformat it.

Don't carry your backup disk around with you, even if it's a portable disk. For convenience, Time Machine is engineered to work with multiple disks, so you can back up at several locations. Connect a second backup disk to your Mac, go to Time Machine's preferences, click the option to select a disk, then choose your secondary backup target from the list that is presented. When asked whether to replace or complement the existing disk, choose 'Use Both'.

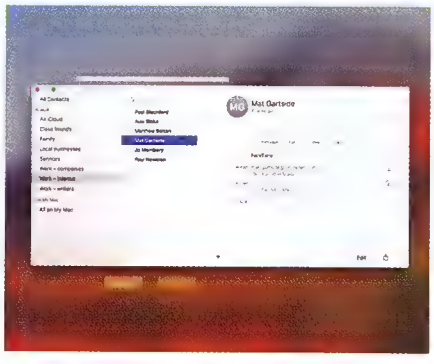
When you reconnect a backup disk, Time Machine backs up all changes to your Mac since that particular disk was last used, not just those since the last backup.

## How to make the most of Time Machine and Versions.



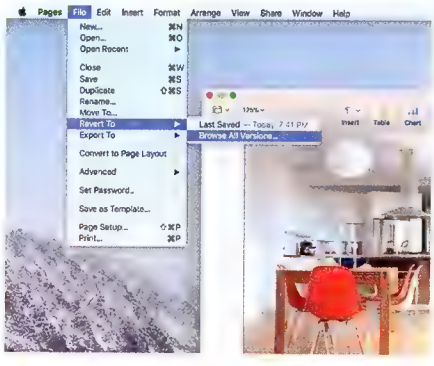

### 1 RESTORE A FILE/FOLDER

Deleted a file or folder you need? Browse to where it was stored, then click Time Machine's menu bar icon and pick 'Enter Time Machine' (or use Spotlight to open the Time Machine app). See the annotation opposite for how to proceed.



### 2 RESTORE ITEMS

Apps that don't save documents may still enable you to restore items; contacts or messages in Mail, say. Open the app and enter Time Machine; you'll be able to step back in time through the app's older contents and recover them.




### 3 VERSION HISTORY

Auto Save and Versions aren't part of Time Machine, but work similarly and complement it. If an app's File menu contains 'Revert To', it works with these features; as soon as you create a doc in an app, save it to benefit from them.

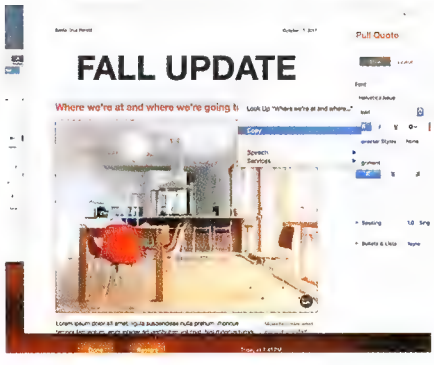
## A quick look at Time Machine's interface:

**1 THE TIMELINE**
Move the pointer over the timeline at the bottom right of the screen. Each notch in it represents a backup's date and time, starting with the most recent one at the bottom.

**2 THE WINDOW**
Click a backup in the timeline and the window in the centre (Finder or the Time Machine-compatible app you were using before entering Time Machine) will change to display its contents.

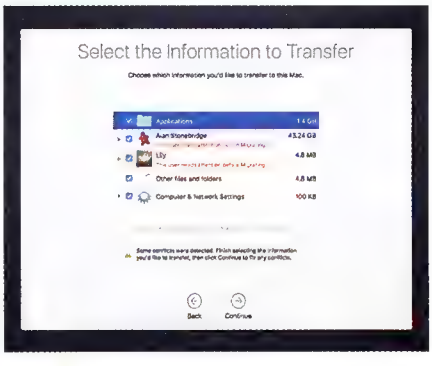
**3 RESTORE OR DELETE**
Select one or more files in the Finder window. Click the Restore button to get the selected version back, or click the cog button in the toolbar, then 'Delete All Backups of [selection]'.

**4 LOCAL SNAPSHOTS**
If a MacBook is away from its backup disk, Time Machine can use the built-in drive for local snapshots. Bright red backups can be restored right away. Dimmed ones require your backup disk.




**4 RECOVER FRAGMENTS**
Choose 'Browse All Versions' there; this works much like Time Machine, with one key difference: as well as rolling back to an older version, you can selectively copy from the old version (right side) and paste into the current one (left side).

**5 RESTORE THE SYSTEM**
To restore to an earlier state, hold Option, power on, and release at the Apple logo. The options you'll be shown include one to restore a backup; further into the process, you select the backup to restore by its time, date and system version.




**6 MIGRATION ASSISTANT**
Already put a clean installation of macOS on your computer? Use Migration Assistant (in 'Applications > Utilities') to restore users, files, apps and settings, Again, you can choose the date and time of a backup, plus what to restore from it.

# Essential iOS 11 tips and tricks

## Take a guided tour through new and improved capabilities of the latest iPhone and iPad operating system.

**There are many new and improved features in iOS 11, aiming to allow you to get the most out of your iPhone and iPad. Whether you held off upgrading for a while, until Apple fixed a few bugs, have just upgraded to a new device in order to run the new system, or are simply hungry for lots of tips and tricks, you'll find plenty of them here.**

Over the next few pages, you'll learn about changes to: notifications and the Lock screen, including how to increase your privacy when your device is locked; improvements to Maps that help you to get around indoors, and to drive more safely; and – one of our favourites – the new things you can do in Notes.

# Lock down notifications

## The basics of notifications remain the same in iOS 11.

They can appear as a banner across the top of the screen, play a sound and display a badge on their parent app's Home screen icon to remind you there are things awaiting your attention. However, there are some important changes to know about. Helpfully, they include the use of clearer language to describe behaviours and hopefully prevent confusion.

In the past, you might have stopped an app showing notifications on the Lock screen because you didn't want it to display potentially sensitive data there. Problem is, you could also miss important notifications. Fortunately, this should no longer be necessary – one of iOS 11's most welcome changes can fix that and maintain privacy.

### 1 BANNERS, PLAIN AND SIMPLE

The first change is a matter of clearer terminology, and will be beneficial if you're new to iOS. Previously, Apple used the term 'banners' to refer to the kind that briefly pop in at the top of the screen and disappear a few seconds later, and 'alerts' for those that look identical but stick around 'til opened or dismissed.

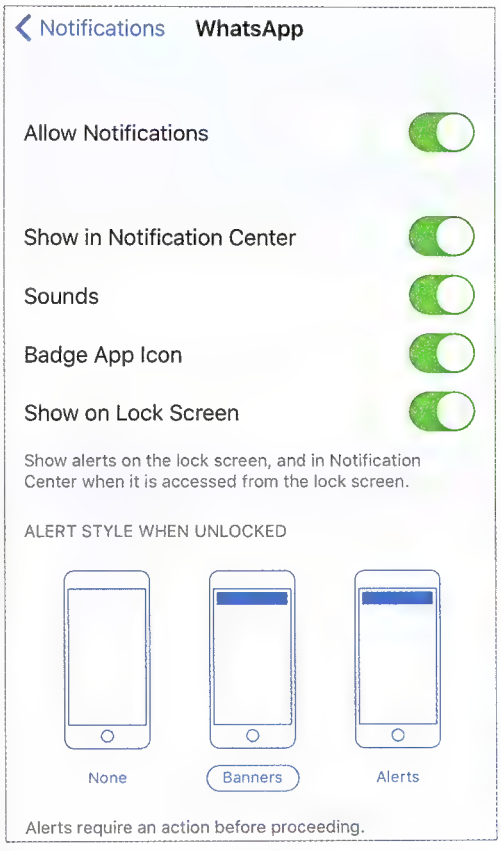
In iOS 11, both are now called banners, and the distinction between them is clearer: in 'Settings › Notifications', tap an app's name and you'll find the two kinds of banner described as 'temporary' and 'persistent'.

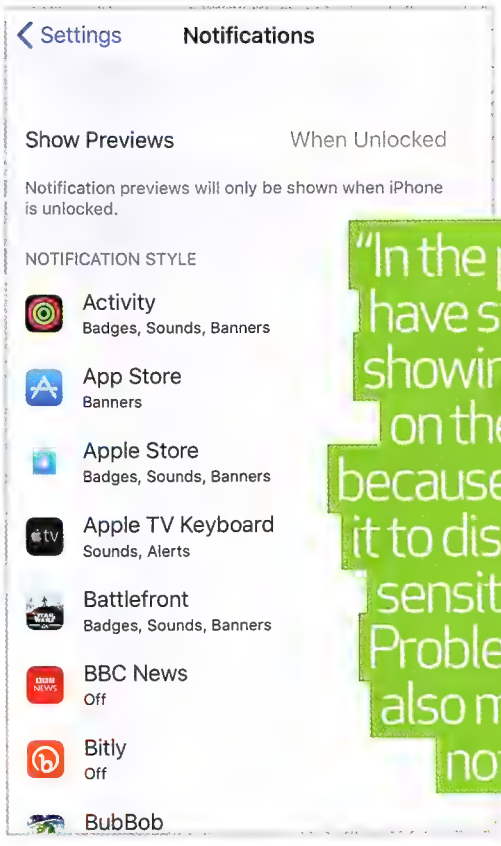
### 2 NOTIFICATION CENTRE & THE LOCK SCREEN

Go to any app's notification settings and you'll see that, while there's still a 'Show on Lock screen' item, 'Show in Notification Centre' has gone. In previous versions of iOS, you could set an app's notifications to appear in one of those places but not the other, which could get confusing. That's no longer possible. Whether you catch up on notifications on the Lock screen or in Notification Centre, you're presented with the same list of items. Really, Notification Centre is now the same thing as the Lock screen. However, there is a new setting for each app's notifications, 'Show in History,' which we'll talk about in a moment.

### 3 INSTANT PHOTOS, WHEREVER YOU ARE

There's a functional benefit to the Lock screen and Notification Centre being the same thing, save for the distinction of whether your device is locked or unlocked (which is important to the next tip, about notification previews). The two locations aren't just the same




"In the past, you might have stopped an app showing notifications on the Lock screen because you didn't want it to display potentially sensitive data there. Problem is, you could also miss important notifications."

in terms of displaying notifications. Even while you're using an app, you can swipe down from the top of the screen to open Notification Centre, then left on an empty area to access your device's camera features in seconds. That gives you a better chance of catching a good photo opportunity whatever you're doing.

### 4 TO PREVIEW OR NOT TO PREVIEW

In previous versions of iOS, notification settings for a few apps – notably Mail and Messages – included a 'Show Previews' option. You could change this from 'Always' to 'When Unlocked' or 'Never' to prevent private info being visible on the Lock screen.

The majority of apps didn't offer this, though. iOS 11 fixes this with a global 'Show Previews' setting at the top of 'Settings > Notifications', providing a way to ensure no info from any app is readable by roving eyes.

This default setting for all of your apps is supplemented by a new 'Show Previews' item within every app's settings. This arrangement gives you more privacy by default, but you can allow apps to deviate from the norm if you're confident that they won't leak anything sensitive.

### 5 REST FINGER TO PREVIEW

Prior to iOS 11, you might have enabled 'Settings > General > Accessibility > Home Button > Rest Finger to Open'. If that's the case and you set the master 'Show Previews' setting to 'When Unlocked', after unlocking your device, you'll have to pull down Notification Centre to read the items that were shown on the Lock screen.

Disable that accessibility setting and, after waking your device, resting your finger on the Touch ID sensor will unlock your device but immediately preview your notifications; press the Sleep/Wake button if you want to lock the device and hide the previews again.

### 6 NOTIFICATIONS HISTORY

There are two tiers to notifications in iOS 11. Tap any app's name in 'Settings > Notifications' and you'll see the traditional 'Show on Lock Screen' item, which is the list of recent and unattended alerts shown as soon as you wake your device or open Notification Centre.

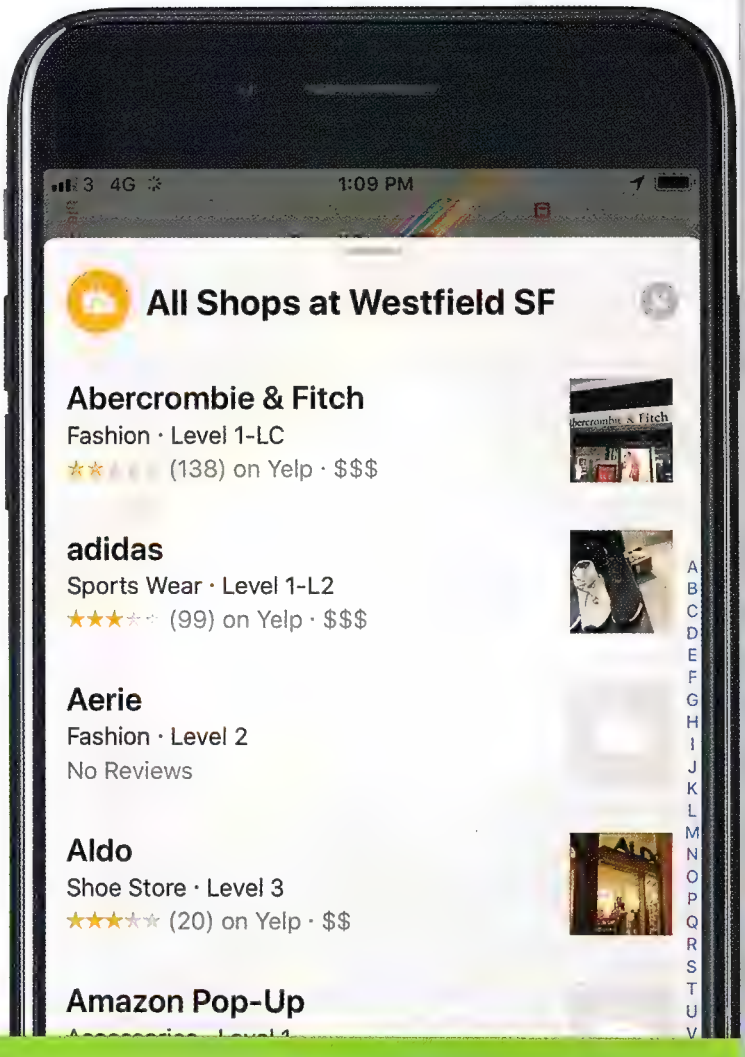
The 'Show in History' item refers to the list of older notifications you haven't acted upon or dismissed, which is shown when you swipe up on the Lock screen or Notification Centre. So you might have the Facebook Messenger app inform you of direct messages on the Lock screen and in Notification Centre, but confine status updates from Facebook to the history, say.

# Find your way with Maps

Apple's Maps service now helps you to navigate indoors as well as out, thanks to the addition of interior maps for shopping malls and airports.

This covers several major cities in the US and many popular destinations around the world already, with more set to be added every month.

There are new features to help keep drivers safe and more informed, plus a useful tweak if you use ride-booking apps.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## Shopping centres and airports

### 1 Interior maps

Floor plans for select shopping centres and airports are now available in Maps, both in 2D and 3D views. If you happen to scroll the map so that a place with an interior map comes into view, tap Browse <place name>, which slides in at the bottom of the screen (iPhone) and appears at the top right (iPad) to browse the full, multi-floor map. The area outside the shopping area or airport is dimmed.

### 2 Switch floors

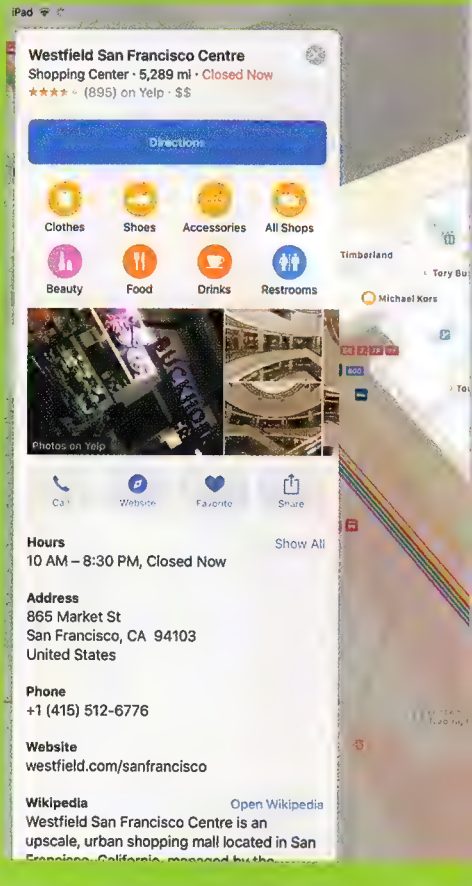
The floor number you're viewing is shown near the top right of the screen. Tap it for a list of all floors, then one of those to see that floor's layout. The list remains open so you can quickly browse marked points of interest across several floors. To close the list, tap the X above it, or an unmarked spot on the map. Stairs, escalators, and lifts are marked on the map to help you plan your route.

### 3 Browse by category

When you've started to browse an interior map, swipe up on the panel to pull it into view (iPhone; it's always in view on iPad). You'll see icons for the various types of business there, public toilets, as well as places to get refreshments; tap one to filter the map to show only that kind. To switch to another kind of business, tap the X at the top right to go back to the list of categories.

### 4 Browse from A to Z

Alternatively, tap the All Shops icon to open a screen-high list of businesses and features within the location, complete with an alphabetical index as a shortcut (like in the Music app), down the list's right edge. In any view of the location, tap a business on the panel or its point-of-interest icon on the map to read more about it; this information includes opening hours, contact details and reviews.



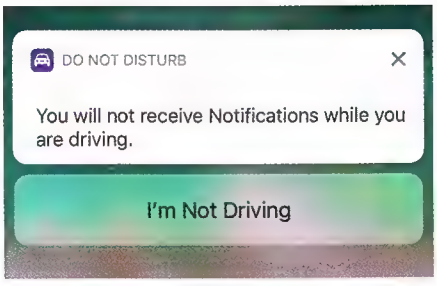
# Do Not Disturb While Driving

## 5 CUT OUT INTERRUPTIONS

Do Not Disturb While Driving (DNDWD) stops notifications popping up when you're driving and distracting you from the road and pedestrians In 'Settings > Do Not Disturb', scroll down to the last three items. The first determines how the feature activates. When it's set to Automatic, your iPhone's Wi-Fi is used to detect the Doppler effect, and DNDWD is turned on if it's thought you're moving in a car.

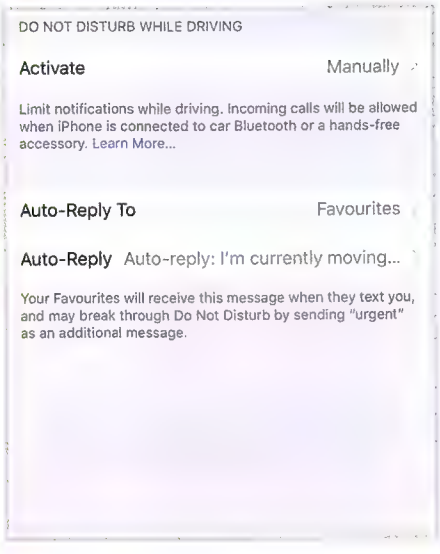
If you wake your device, you'll see a notification that tells you the feature is active. Open that for an option to override DNDWD if you're a passenger or on public transport.

The feature can be set to enable as soon as your iPhone connects to your vehicle's Bluetooth system, or you can choose to turn it on manually. To do the latter, you'll need to add a button to Control Centre: go to 'Settings > Control Centre > Customise Controls' and tap the + next to DNDWD.




## 6 SEND AUTO-REPLIES

Your iPhone can reply to let people know why their attempts to reach you are going unanswered. DNDWD's second setting specifies who receives these messages: no one, people you've replied to in the last day, your favourite contacts, or everyone. People in your chosen group can break through DNDWD by sending 'urgent' as a second message. Apple provides a preset response. You can personalise that message in DNDWD's third setting.


DO NOT DISTURB WHILE DRIVING
Activate
Manually
Limit notifications while driving. Incoming calls will be allowed when iPhone is connected to car Bluetooth or a hands-free accessory. Learn More...
Auto-Reply To
Favourites
Auto-Reply
Auto-reply: I'm currently moving...
Your Favourites will receive this message when they text you, and may break through Do Not Disturb by sending "urgent" as an additional message.

## 7 LIMIT CHANGES

Got a teenager in whom you want to instill a sense of road safety? You can prevent DNDWD's three settings being changed (in the fifth group down in 'Settings > General > Restrictions'). Beware that although this stops changes to the feature kicking in automatically and the message it sends, your child can still override the feature.

## New features for navigation

### 8 Speed limit indicators

During directions, Maps may show the speed limit for the road you're on. Don't want the guilt trip? Go to 'Settings > Maps > Driving & Navigation' and turn off Speed Limit under 'Show in Navigation'.

### 9 Quickly switch view

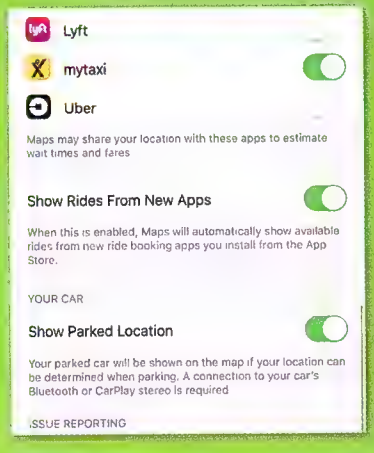
You can now more quickly switch between following turn-by-turn directions and an overview of your journey: tap the current instruction at the top of the screen.

### 10 Orient the overview

When you switch to the overview, a compass briefly appears at the top right. Tap it to switch between the top of the screen being aligned to North, or your destination. (When the compass is hidden, tap the map to reveal it.)

### 11 Show rides from newly installed apps

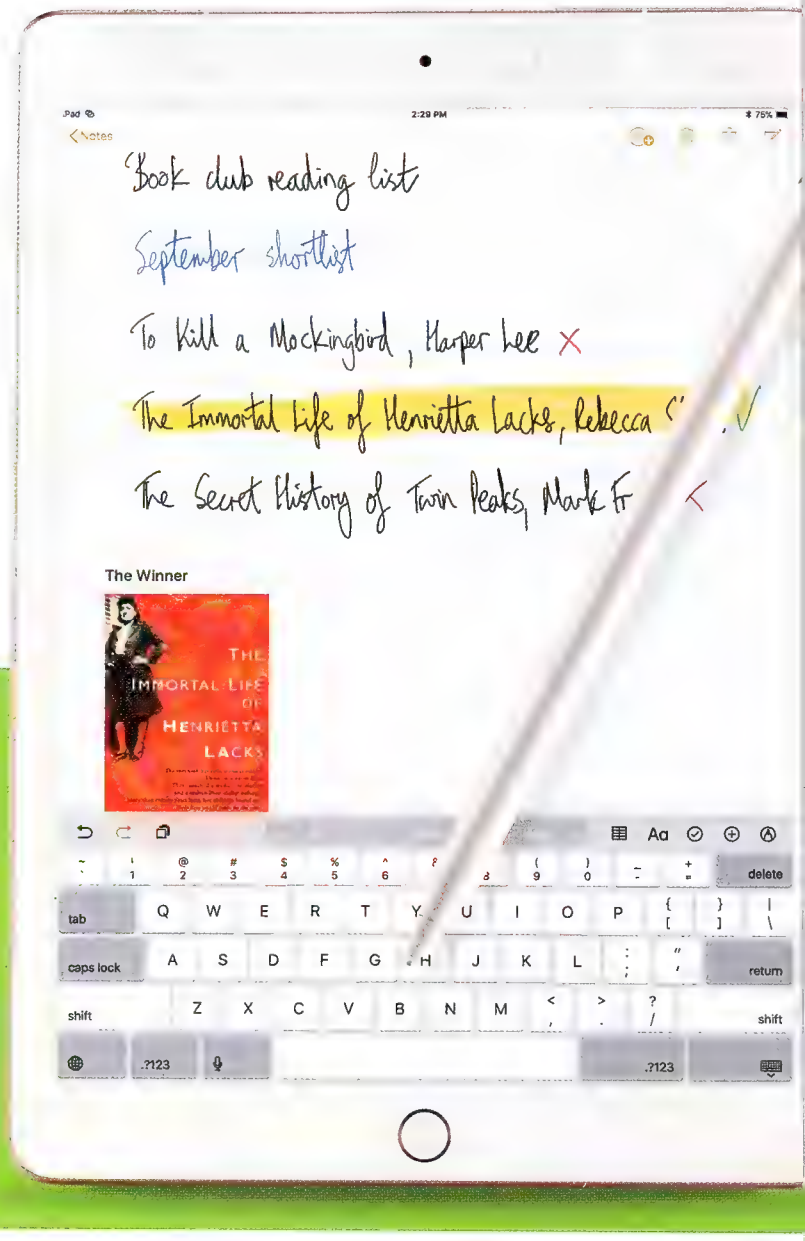
When you ask for directions, Maps can suggest ride-booking apps that are already installed (in 'Settings > Map's, under 'Ride Booking Extensions'). You might have turned this off, perhaps because you prefer to only use those services' apps when they are your only option in a neighbourhood. But you can choose to have ride-booking apps you install in future offered in Maps by default. To do so, turn on 'Show Rides From New Apps' in Maps' Settings page.


Lyft
mytaxi
Uber
Maps may share your location with these apps to estimate wait times and fares
Show Rides From New Apps
When this is enabled, Maps will automatically show available rides from new ride booking apps you install from the App Store.
YOUR CAR
Show Parked Location
Your parked car will be shown on the map if your location can be determined when parking. A connection to your car's Bluetooth or CarPlay stereo is required
ISSUE REPORTING

# Make richer notes

Apple has improved Notes a lot in recent years. You can already add sketches, checklists and images, and format your text.

iOS 11 builds on this with better-organised text formatting options, so text styles, list styles and indentation settings are accessed through more distinctive controls. But what's really cool are the shortcuts that enable you to create notes from the Lock screen, plus all the new things you can add to notes.


Book club reading list
September shortlist
To Kill a Mockingbird, Harper Lee
The Immortal Life of Henrietta Lacks, Rebecca
The Secret History of Twin Peaks, Mark Fr
The Winner
THE IMMORTAL LIFE OF HENRIETTA LACKS

## Quick note creation

### 1 Start a note

You can tap your Apple Pencil on an empty part of the Lock screen (or use Control Centre's new Notes button) to start taking notes. This shortcut can be turned off in 'Settings > Notes > Access Notes' from the Lock Screen.

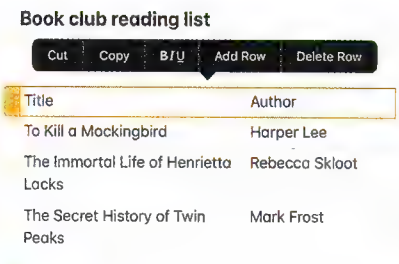
### 2 New or resume?

You can choose to always create a new note, resume the last note created at the Lock screen (with an optional duration after which you get a new note) or resume the last note viewed in the app, with a passcode timeout.

## Quick note creation

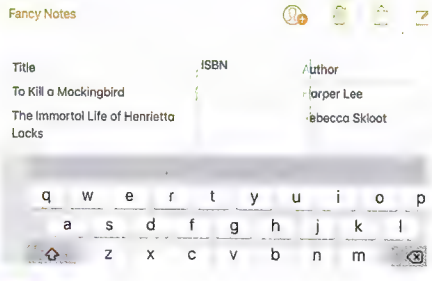
### 3 ADD COLUMNS AND ROWS

Tap the table icon to add a table. Tap a cell to the right of or below which you want a new column or row, then tap the three dots above it or at the far left, followed by Add Column or Add Row.




### 4 FORMAT COLUMNS/ROWS

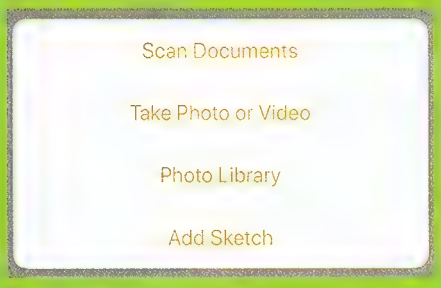
Tap the three dots above/left of a column/row to select the whole column or row; provided one cell in your selection contains text, the options bar will contain a formatting option, labelled BIU.




### 5 REORDER COLUMNS/ROWS

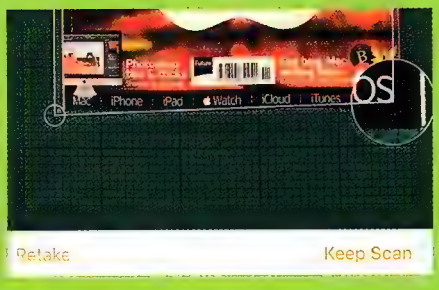
Want to rearrange the columns or rows in your table? Hold a finger on the three dots above the column or at the far left of the row to pick up that range of cells, then drag to a new position.

# How to: Scan documents




**6 START SCANNING**
While editing a note, tap + above the keyboard, then Scan Documents. Point the camera at the paper, set against a contrasting background to help the app discern the page's edges.

**7 DETECT THE PAGE**
A yellow overlay appears over the detected page. It may appear jittery. The shutter is set to auto-take shots by default; switch from auto to manual if you find it triggers too early.

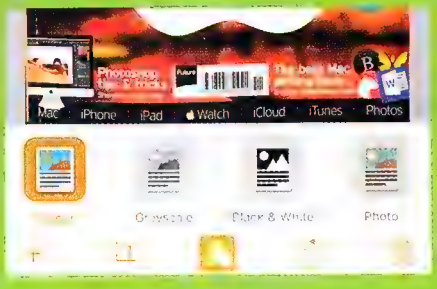



**8 FINE-TUNE THE CORNERS**
Four handles appear at what the app thinks are the page's corners. You can drag them to adjust their positions. If you're dissatisfied with the shot, tap Retake, otherwise tap Keep Scan.

# How to: Add to and refine your scans

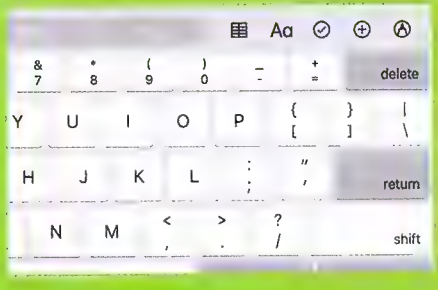
**9 ADD MORE PAGES**
Notes will stash the page at the bottom of the screen, and remain in camera mode for you to add more pages. Tap Save when you're finished.

**10 CHECK YOUR SCANS**
Tap the scans in your note to take a close look; the pages should be straightened. Tap + to add more, or the trash button to delete the page in view.



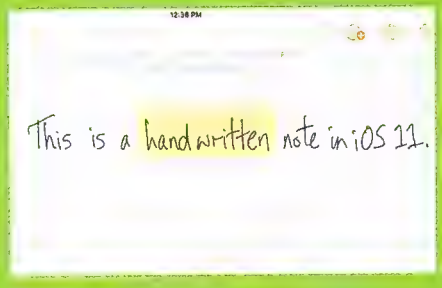

**11 ADJUST THE LOOK**
Tap the overlapping circles to add a colour, photo, greyscale or black-and-white filter. The crop tool takes you to the original photo to adjust page corners.

# How to: Make handwritten notes



**12 START WRITING**
In a new note or an existing one, after positioning the insertion point, tap the pen icon at the top right of the keyboard. Notes uses the same writing tools as iOS 11's Instant Markup feature.

**13 CHOOSE STATIONERY**
A background is added to your notes based on your choice in 'Settings > Notes > Lines & Grids'. To override it for any individual note, tap the Share icon, then Lines & Grids in the bottom row.




**14 NAME YOUR NOTES**
The topmost words added to a handwritten note appear as its name in the list; scroll up past the top of the note to edit that. Tap 'Find in Note' in the Share sheet to search your written text.

# Build your own Linux distro

Nate Drake helps you spread your wings and fly away with your own version of Linux.

**Much as we all may love Justin Bieber, it's debatable whether the pop star deserved his own version of Linux. The fact that the internet community has afforded us 'Biebian' Linux (biebian.sourceforge.net) is a testament to both their ingenuity and sense of humour.**

It may come as a slight relief to non-Beliebers that this operating system wasn't built from scratch, but is in fact a variation of the ultra-lightweight Puppy Linux. Even non-fangirl versions of Linux such as Ubuntu are based on older systems (in this case Debian).

This is the upside to living in a world that gave us operating systems devoted to Justin Bieber, Hannah Montana and Satan. The free and open-source Linux kernel allows for distributions (distros) in thousands of so-called 'flavours'.

For you as the end user, this can be truly overwhelming, so most newcomers to Linux stick with well-known distros such as Ubuntu and Linux Mint. While we heartily endorse your efforts to keep life simple, Linux isn't constrained in the same way as Windows. Most distributions support a number of desktop environments designed for flashy visual effects or efficiency. You can change aspects of your system from simple things like the colour of icons and windows, to how windows are arranged on the screen and how you launch applications.

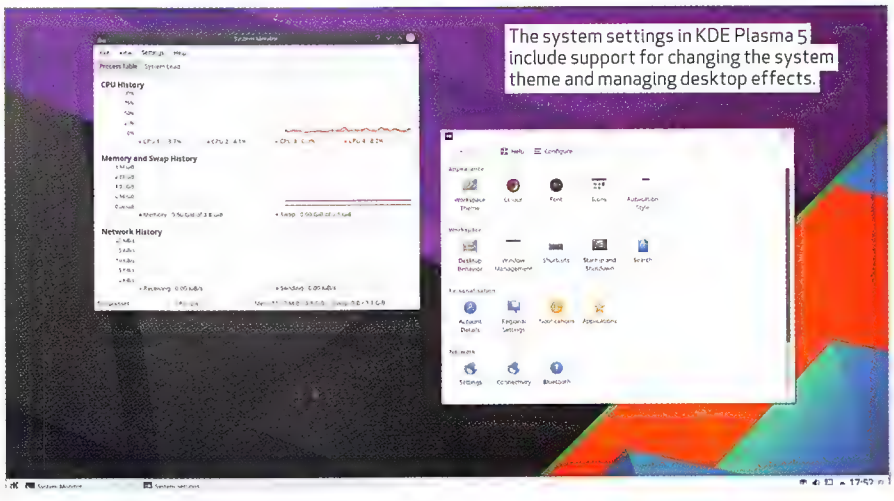
In this guide, we'll help you to select a basic distribution of Linux complete with a desktop environment and make it your own. In the first few sections, we'll explore how to change aspects of the graphical interface of your current system by installing window managers, panels and custom themes. If you want more control over your system, you can also use SUSE Studio's handy online wizard, which enables you to create an installable Linux image complete with desktop background, pre-installed software and even your own personal files.

# Desktop environments

## Choose the base system that you want to customise.

Part of the joy of Linux being open source is that there are a number of desktop environments you can choose. This is entirely a matter of personal preference, based upon your needs and how powerful your hardware is.

While you can install multiple desktop environments on the same machine, it's simpler to choose a distro of Linux that comes with it preinstalled. Most Linux operating systems also come with a set of applications optimised for the default desktop environment.



The system settings in KDE Plasma 5 include support for changing the system theme and managing desktop effects.

### WHOSEBUNTU?

Up until Ubuntu 17.04 (Zesty Zapus), the default version of the ever-popular operating system made use of the Unity Desktop, which is still in use on the LTS (Long Term Support) versions of Ubuntu. However, Ubuntu 17.10 and onwards use the Gnome environment.

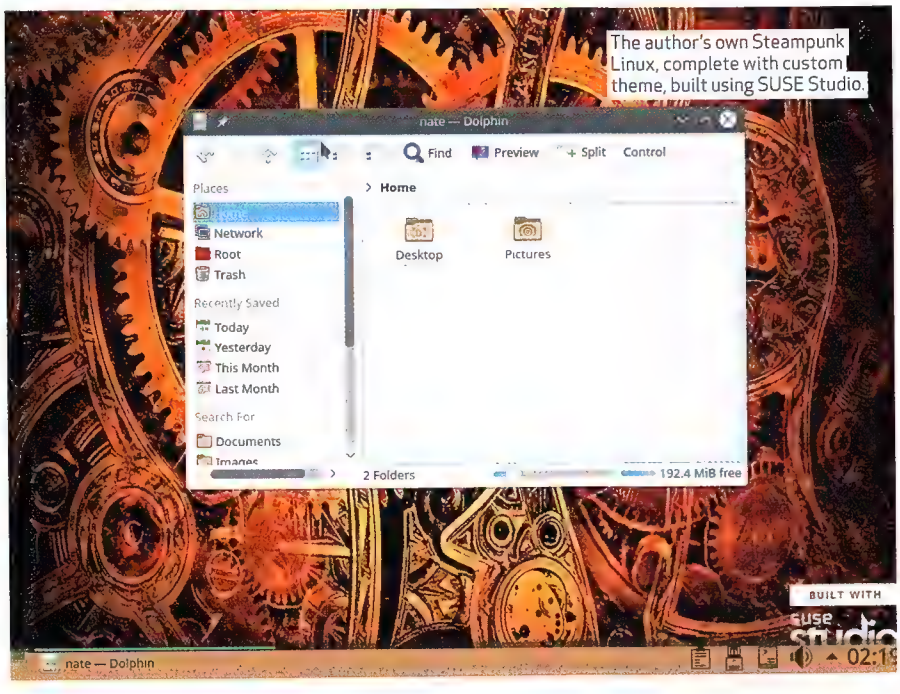
Gnome is designed for accessibility and productivity. Its official interface, the Gnome shell, incorporates a categorised Applications menu, system menu and a clock. It also supports an overview mode that enables you to view all currently active windows.

Certain applications such the AbiWord word processor or Evince PDF viewer are optimised for use with Gnome, which means they'll display correctly and work with desktop widgets. You can find a list of these **wiki.gnome.org** if you wish to experiment. Visit **www.ubuntu.com/download/desktop** to download Ubuntu 17.10.

A main rival to Gnome is the KDE Plasma Desktop, which is the environment of choice for operating systems such as openSUSE and Kubuntu. By default, KDE includes a small taskbar at the bottom of the desktop.

There's also a huge KDE community that works in tandem with the developers behind Plasma to create custom applications, such as Okular, a universal document viewer and the Kontakt productivity suite in Ubuntu. The KDE version of Ubuntu itself is called Kubuntu and is available from **kubuntu.org**.

The KDE Plasma Desktop also supports a number of desktop effects such as Present Windows, which enables you to view and switch applications similar to Gnome's overview feature. See **userbase.kde.org/Desktop_Effects_Performance#Desktop_Effect_Performance** for more details.



The author's own Steampunk Linux, complete with custom theme, built using SUSE Studio.

### LIGHT AND NERDY

If you value speed over glamour, consider choosing a version of Linux using LXDE (Lightweight X11 Desktop Environment). LXDE has the lowest memory usage of major desktop providers and, as such, is perfect for older machines. Lubuntu, the version of Ubuntu running LXDE, can run quite happily on 512MB of RAM.

LXDE's slick interface includes the LXLauncher, which enables you to launch applications at a dizzingly fast speed. The default PCManFM file manager is equally rapid, if rather basic. LXDE also incorporates the lightweight LXTerminal emulator and the zippy Openbox Window Manager. Download Lubuntu from **lubuntu.net**.

Special mention should also go to Xfce, which is also designed to be lightweight and fast but is rather more visually appealing than LXDE. It supports more advanced effects such as drop shadows behind windows, as well as a beautifully laid out file manager. The Ubuntu variant of Xfce is known as Xubuntu and is available from **xubuntu.org**.

# Windows and panels

## Fine-tune your flavour of Linux with your own window and file managers.

Whichever version of Linux you chose will almost certainly incorporate its own Window Manager. These serve as clients to the 'X' Windows system and, in essence, they live up to their name in that they determine the appearance and behaviour of any windows used by graphical applications.

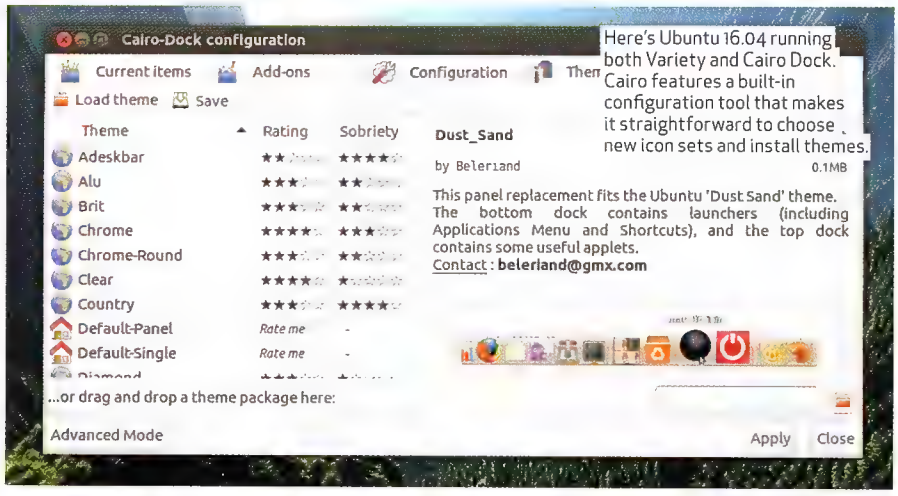
While you may be of the opinion that one window is much like any other, your manager of choice can have huge implications for your productivity. For instance, you may prefer a stacking window manager that enables you to place windows on top of one another, as you would on a Windows machine or a Mac. On the other hand, you may prefer a tiling window system which ensures that no two windows overlap. There are even dynamic window managers which can switch between the two.

The Arch Linux wiki maintains a comprehensive list of various window managers (**wiki.archlinux.org/index.php/Window_manager**). Rest assured that you don't need to be using Arch to benefit from this.

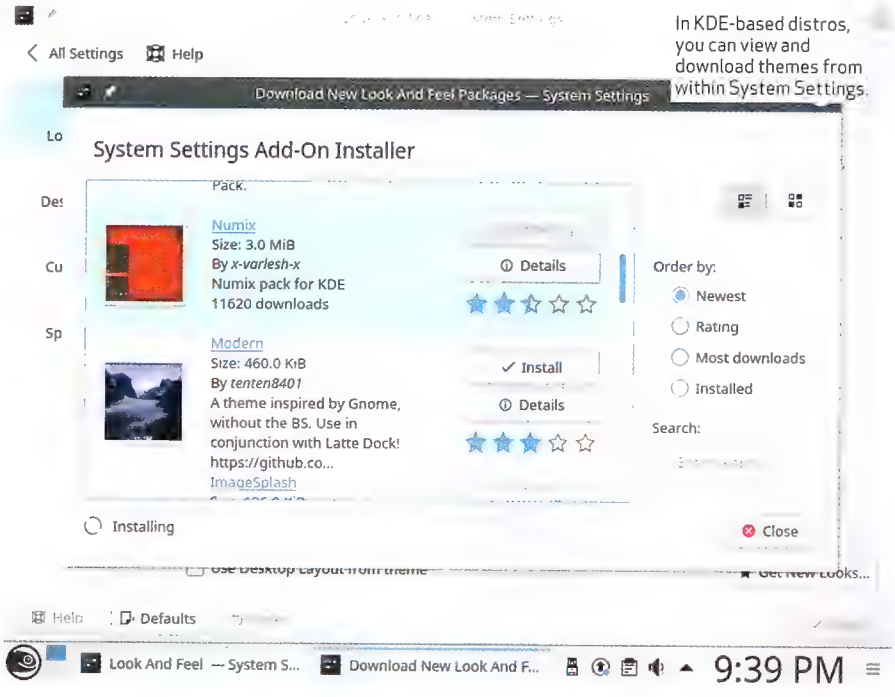
The installation steps for window managers also vary. For instance, if you wish to install the lightweight Openbox window manager in Ubuntu, you only need to open Terminal and type `sudo apt-get install openbox obconf` The 'obconf' utility is optional, but helps you change other system settings such as window colours and fonts. Panels are used for listing and launching programs and locations on your machine. For instance, the default Gnome desktop has a top panel with navigation menus to Applications, Places and System settings whereas the bottom panel is used to switch between active windows. Most panels can be customised to include new menu categories as well as launchers for your favourite applications.

Your panels are usually determined by your chosen desktop environment but you can install others as you wish, such as the Mac-like Cairo Dock (shown above), to the fast and lightweight Docky, both of which are available for install via Ubuntu Software. If you're using Ubuntu with Unity or Gnome you can find more docks and launchers at **www.gnome-look.org/browse/cat/277**.

If you're happy with your desktop environment and just want to alter the colour or layout of menus and panels, then you may be able to do this using a Theme Manager (see walkthrough, opposite).



Here's Ubuntu 16.04 running both Variety and Cairo Dock. Cairo features a built-in configuration tool that makes it straightforward to choose new icon sets and install themes.



In KDE-based distros, you can view and download themes from within System Settings.

### VARIETY'S THE SPICE OF LIFE

Once you have your windows and panels in place, take some time to choose a desktop background. For most Ubuntu-based distros, you only need to right-click anywhere on the desktop and choose 'Change Desktop Background'. You can select from those which are preinstalled or click the '+' button to add one of your own.

If you find that the novelty of this wears off, consider installing Variety using Ubuntu Software. This tiny yet powerful program can be configured to cycle through various desktop backgrounds, either from on your machine or online. Images come from diverse sources such as NASA views of the Earth, Flickr and even Reddit. You can control the frequency at which your background changes, from a few seconds to every 24 hours.

### BE A THEME PLAYER

Most versions of Linux support installing themes. These are files that can alter the overall look and feel of your operating system such as the

icons for applications, the colour of windows and docks and sometimes even new fonts and cursors.

Versions of Linux that use KDE enable you to download and install new themes and icon sets from within the system. Click the launch menu and choose 'Settings > Workspace Theme'. If none of the preinstalled themes appeal, click 'Get New Looks' to see a list of compatible themes in the KDE Store. Select Install next to any of these and, once the download is complete, select the theme and click Apply to use.

The process for installing a new set of icons works in a similar way: choose 'Icons' instead of 'Workspace Themes', then select or install new icons in the same way.

If you're using a Unity- or Gnome-based distro such as Ubuntu 16.04 LTS or Ubuntu 17.10, respectively, then you can download and install new themes using the Gnome Tweak tool. Follow the steps in the guide below for more help with this. You can find both themes and icons sets online. Two popular sites are **gnome-look.org** and **ubuntuthemes.org**.

If English isn't your first language or if you don't adhere to American spellings and date formats – like us – you most likely will need to change your distro's default settings.

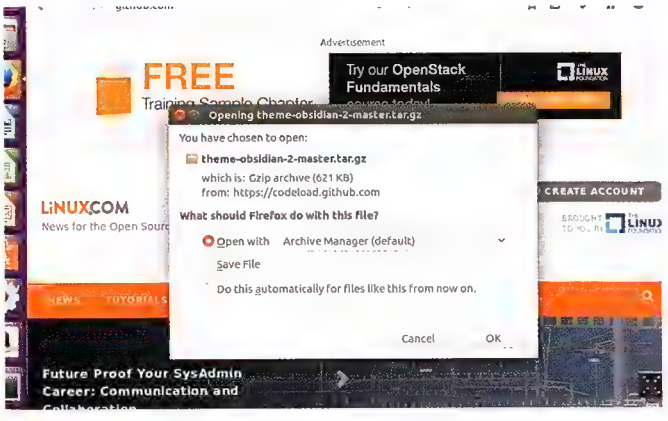
### MIND YOUR LANGUAGE

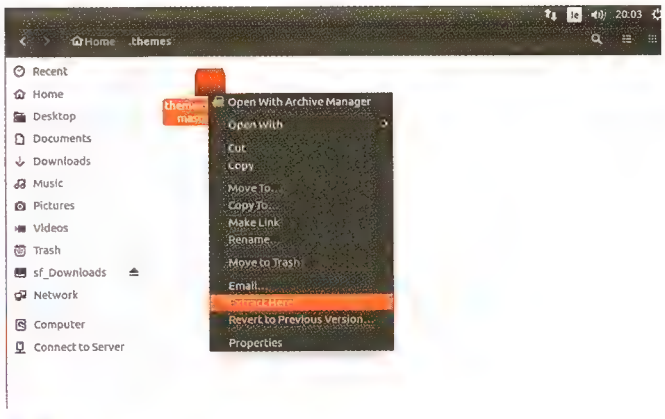
In Ubuntu, you can do this from the Language Support section of the Windows settings. If you've selected a different language during setup to the one used by the system for any application, such as Australian English, Ubuntu will ask if you want to download extra language packs. Click 'Regional Formats' to select your region, which will inform your default currency, time and how numbers are displayed. If you're using a KDE-based distro, go to 'Settings > Language'. From there, you can set your preferred language. You can also click Formats in the sidebar to set your region.

If you have a set of preferred applications, now would also be a good time to install them using your distro's package manager. If you've chosen a version of Linux that you haven't used before, try to make use of the preinstalled apps which have been optimised for use with that desktop environment.

Once you're happy with how your custom distro of Linux is looking, you can avoid having to go through the setup process again from scratch by making regular backups of your entire hard drive using a utility such as Clonezilla, so you can restore it if necessary. See **www.techradar.com/how-to/how-to-clone-your-hard-drive-with-clonezilla** for help with this.

# New themes and icons



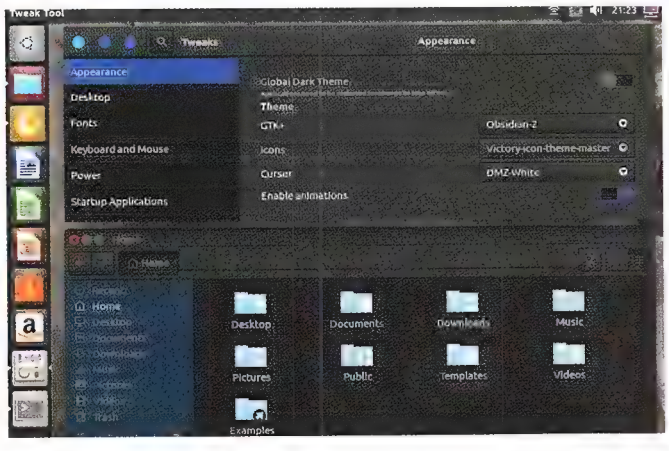




### 1 FIND YOUR THEME

Go to **gnome-look.org** to find your chosen theme. Look in the GTK2 Themes and GTK3 Themes categories. If you're using Ubuntu with the standard Unity desktop rather than Gnome, some of these themes may not be compatible. Read through the comments section for each theme to check if it's been installed previously in Ubuntu. To install an icon pack, click the 'Icon Themes' section.

### 2 SAVING THE THEME

Open your file manager and navigate to your home folder. Hold down 'Ctrl-H' to display hidden files, then scroll down to find the folder named .themes. If the folder isn't there, you can create it by right-clicking and then selecting 'New Folder'. Copy and paste the downloaded file into this folder. If it's compressed, right-click and choose 'Extract Here'.




### 3 LOAD YOUR THEME

Open Ubuntu Software and enter the words "Gnome Tweak" in the search bar. Click Install to begin downloading the app. If you're using the mainstream version of Unity, the icon for the Tweak tool will appear automatically in the launcher. Open the Tweak tool from the launcher on the left and select Appearance on the left-hand side. Click the drop-down menu that's alongside GTK+ and select your chosen theme. If the theme doesn't include an icon set, you can also install one by repeating the steps above, but save the file to the .icons folder in your home folder instead of .themes. You can select your new icon set from the Appearance section of the Gnome Tweak tool by clicking the corresponding drop-down menu.

# Distro wizardry

## Build your own downloadable version of Linux using SUSE's online wizard.

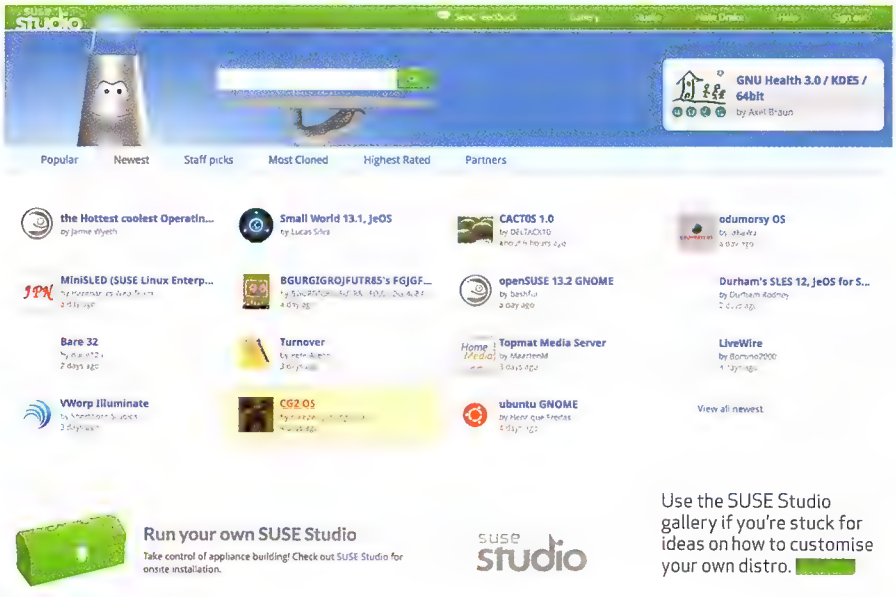
As fun as it is working methodically through the various features of Linux, wouldn't it be much more convenient if there was some kind of program that did all the hard work for you?

Over the years there have been a number of tools such as UCK (Ubuntu Customization Kit) that aim to help you create your own distro. However, during our tests none of them worked with recent versions of Ubuntu.

The story is a little different for those who favour RPM-based distros of Linux, because the good people at SUSE have put together an excellent online wizard to create your very own installable version of Linux based on openSUSE or SUSE Enterprise.

SUSE Studio, as it's known, walks you through the process of creating your own so-called 'appliance', determining what software to preinstall, choose your own desktop background and logo, as well as upload your personal files. If you're stuck for inspiration, take a look at the SUSE Gallery (**susestudio.com/browse**), which showcases custom SUSE distros that have been created by other users.

The guide (opposite) takes you through the basic steps of setting up your own distro, including how to configure startup settings such as automatic login as well as launching programs and/or scripts on boot.




Use the SUSE Studio gallery if you're stuck for ideas on how to customise your own distro.

### TRY BEFORE YOU BUY

If you've never used an RPM-based Linux distribution such as Red Hat, Fedora or openSUSE, then you may wish to download a standard version to try it out before creating your own customised Linux.

OpenSUSE uses a different package manager to Debian-based distributions such as Ubuntu. This means that any Linux tutorials you find for Ubuntu either online or in Linux Format may not work in openSUSE.

There are RPM versions of most popular Linux programs such as Mozilla Firefox, but make sure to check this in the Software section prior to installing. SUSE Studio supports adding repositories as well as manual uploading of RPM files if there's a particular application you need.

If you've heeded our dire warning and wish to press ahead with creating your own version of Linux in SUSE Studio, then you'll need to transfer the completed files to a medium such as a USB or DVD in order to install them to your machine.

When the time comes to build your Linux distro, we recommend you choose a Live CD/DVD. This will enable you to boot and test your custom version before installing. If you wish to make any changes, it's far easier to do so in SUSE Studio by going through their wizard.

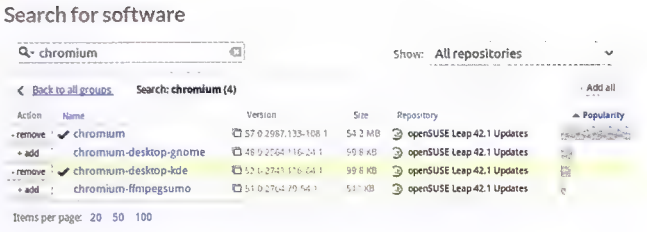
Alternatively, use SUSE Studio's Testdrive feature to experiment with your distro in a web browser. Linux users downloading an ISO image of their distro can install a burning utility such as Brasero or K3b to copy the files to disk. Finally, if your target machine doesn't have a DVD drive fitted, consider downloading Unetbootin from **unetbootin.sourceforge.net**, which can be used in combination with a USB stick to create a bootable disk.

Justin Bieber Linux (aka Biebian) was created as a joke, but is actually a fully-functional version of the open-source OS.

# Build your own distro

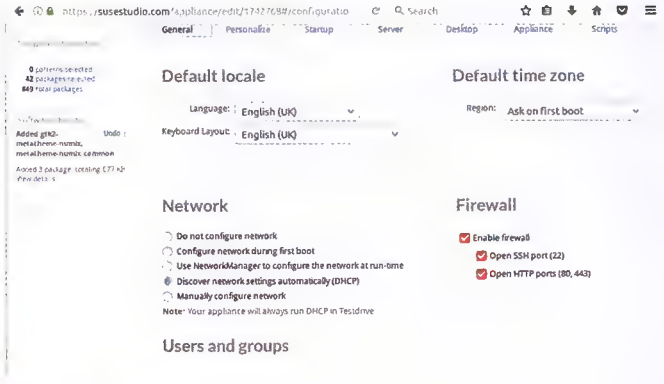
## 1 CHOOSE A TEMPLATE FOR INSTALLATION

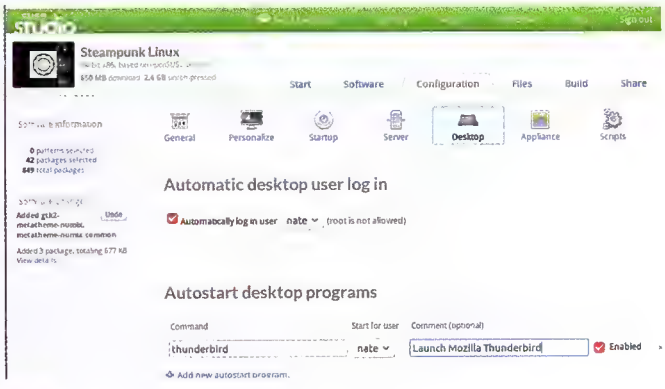
Head to **susestudio.com**. Sign in and click 'Create Appliance' at the top left. Choose a base template: either openSUSE (the recommended option) or SUSE Enterprise. For desktops, you have KDE Plasma or Gnome. Scroll to the bottom of the screen to the 'Name your appliance' option and then click Create. SUSE Studio will now create a new appliance.




## 2 MANAGE YOUR SOFTWARE

At the Welcome, click the Software tab. Scroll down to 'Search for software'. Click Add next to an app name to include it. Missing a program? Scroll up to 'Software Sources'. Click 'Import new repository' and select Add. Can't spot your favourite repository? Click 'Add a Repository via URL'. Type the repository name and URL in the respective boxes, then click 'Add Repository'.



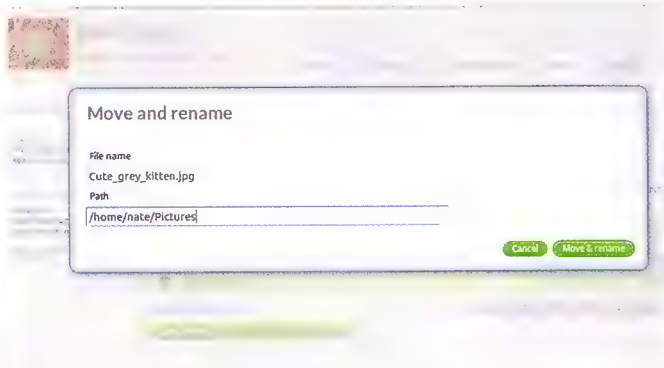



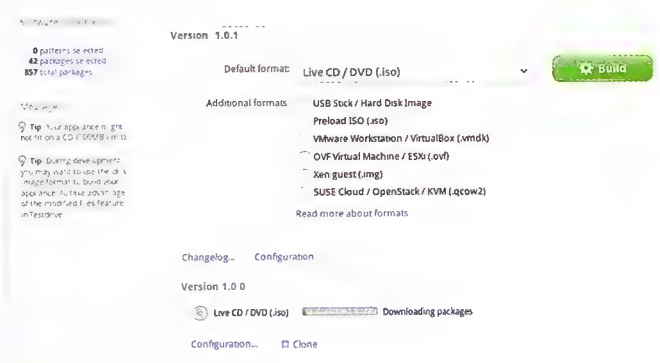

## 3 CONFIGURATION

Click the Configuration tab. Set the Default locale and Default Time Zone. Ignore the Network and Firewall settings. Select 'Users and groups', and update the username and password. Click Personalize under Configuration. Click 'Upload new logo' and 'Upload Desktop background', making sure to select your updated ones. Scroll down to see how these will appear on the desktop, login screen and so on.

## 4 STARTUP SETTINGS

The Startup section is if you don't wish to log into a desktop. You can also ignore the Server section, unless that's your aim here. Click Desktop to enable automatic login as well as which commands can run when Linux starts. If you wish to run actual scripts, move to the Scripts section, from where you can write code that will run either post-install or each time your system boots.




## 5 MANAGE FILES

The Files tab determines the files automatically included. Use 'Upload File' to copy a local file or 'Add from the Web (URL)'. Wait for SUSE Studio to upload files, then click 'Edit details'. This enables you to manage permissions. Choose your own username as the owner, then select the level of access others have. Click Move/Rename to select where your files should be stored, such as in your Pictures folder.

## 6 BUILD YOUR INSTALLATION IMAGE

Click the Build tab. Set a version in the Version text box. Click the Default format menu; the default (USB Stick/Hard Disk image) is the most useful, followed by (Live CD/DVD). Click Configuration to see a summary of all the changes. If you're satisfied, click Build to start the process. Feel free to click Testdrive to take it for a spin. Finally, select Download once you're satisfied with the results.

# Build a midrange AMD Ryzen rig

Zak Storey discovers what going with AMD's Ryzen on a budget of around 1,500 bucks can get you.

## THE CONCEPT

We have a bad habit of focusing too much on the high end, and not enough on what really matters. Say what you like, but the halo products aren't what make or break a company. And although manufacturers make their biggest margins on the most expensive components, it's the mid-range and budget sections of the spectrum that secure the most market share. Which is why, more often than not, they're the more interesting products. Ask any of our team which processor interested them the most over the last two years, and the answer almost always falls down to either the Pentium G4560 or the Ryzen 3 1200.

Anyone can spec out a high-end, pixel-crushing, calculation-solving monster. But it takes a true master to get the most out of a tighter budget. Every dollar counts – far more so than with the inefficient price-hiked parts of the high-end machines. And that's what we wanted to look at this time around. The concept was simple: Take a $1,500 budget, pick mid-range components and come out with a solid, fun, and fast 1080p gaming machine, using AMD parts for the GPU and CPU.

The Ryzen 3 1300X was the base for this build. After numerous high-priced systems, it was nice to get a little more down to earth with a budget part, a stock cooler and some neat money-saving ideas, without losing out on the speed we associate with systems that can cost twice the price of this one.

## CHOICES, CHOICES

We've been itching to try out this case for a while. Phanteks' P300 case is an astonishing achievement of budget-busting ingenuity. Featuring tempered glass, RGB LEDs, a sophisticated internal chassis design, PSU cover, dust filters, room for 280mm AIOs and extensive storage support, this beautifully crafted case comes in at just $85. Honestly, it's almost impossible for us to recommend any other chassis at this price point right now. Regardless of your budget, it's simply too good.

As we said, we decided to go with the Ryzen 3 1300X as our base; a quad-core part, with enough grunt to pump through triple-A titles with ease, especially at that 60fps sweet spot. On top of that, we added Gigabyte's Aorus Radeon RX 570 refresh. With higher clock speeds and 4GB of VRAM, it'll make quick work of any of our 1080p titles, and look pretty flashy while doing it. Its compact size also helps with the build, because it doesn't look as though we'll run into any clearance issues with it.

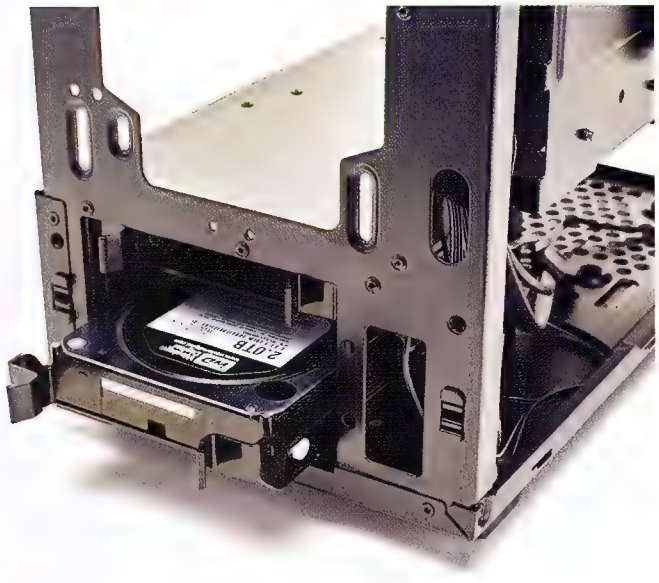
Amazingly, under full load, this system should draw an estimated 326W from the wall at most, so we opted for a non-modular 500W Bronze PSU from Corsair. Although we don't intend to overclock our Ryzen chip, having the extra headroom is useful in case we change our minds later down the line, and also helps if we ever decide to upgrade to a beefier GPU.

For storage, we stuck with that old staple of the modern system: a 120GB SSD for the OS and a 1TB-plus (in our case, 2TB) HDD for everything else. Samsung's 120GB 750 Evo comes in at a reasonable $130, and provides a perfect platform for this build, while the WD Black is more than enough for our gaming needs.

### PARTS LIST

| PART | | STREET PRICE |
|---|---|---|
| CASE | PHANTEKS ECLIPSE P300 ATX MID TOWER | $85 |
| MOTHER-BOARD | GIGABYTE GA-AB350-GAMING 3 | $159 |
| CPU | AMD RYZEN 3 1300X | $169 |
| MEMORY | 16GB (2 X 8GB) CORSAIR VENGEANCE LPX—2666 | $259 |
| GPU | GIGABYTE RADEON RX 570 AORUS 4GB | $369 |
| PSU | CORSAIR CX500 500W 80+ BRONZE PSU | $85 |
| STORAGE 1 | 120GB SAMSUNG 850 EVO 2.5-INCH SSD | $130 |
| STORAGE 2 | 2TB WD BLACK SERIES 7,200RPM HDD | $180 |
| COOLING | STOCK | FREE |
| OS | WINDOWS 10 HOME | $140 |
| TOTAL | | $1,576 |

> "Having the extra headroom is useful in case we change our minds later down the line."



### 1 TEST TIME

We don't say this often enough: for most new builds, to save time and effort, it's best to test most of your components outside the case. A good way to do this is to build your system on top of the box the motherboard came in. The cardboard box acts as an anti-static test bench, and by testing it outside the chassis, if you have a problem with the motherboard, CPU or anything else, you can quickly resolve the issue with the supplier, without having to rip everything out of your system. Word of warning: do not place your motherboard or GPU on top of the anti-static bags they came in, because the outside of the bags actually conducts electricity.

### 2 HDD INSTALLATION

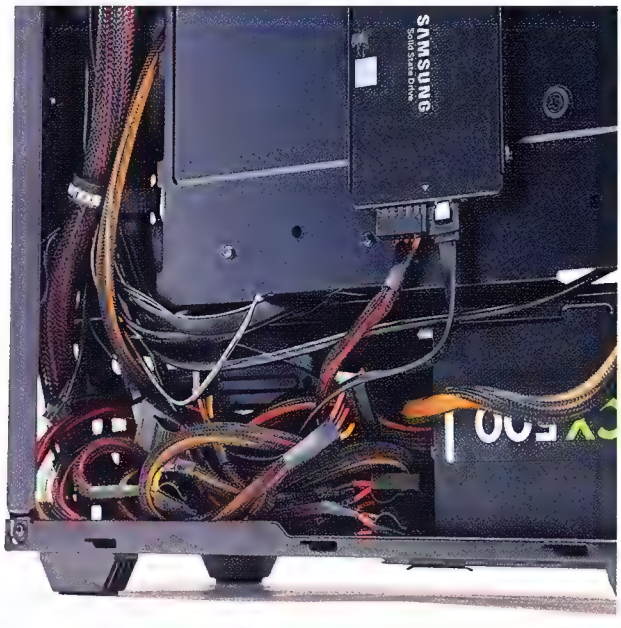
The next step for any build is to strip the case down as far as you can, removing all the side panels, the roof and the front covers if possible. In the P300's case, once you do this, you gain access to the hard drive cages, because they pull out from the front of the chassis. Make sure you install the hard drives with the connectors facing backward — toward your power supply — and you shouldn't have too much of an issue. Some hard drives may not fit in the stock caddies, so you might need to get inventive with the toolless mounting (we had to remove the two clips and secure ours with screws).

### 3 STOCK COOLER INSTALLATION

There's no glitz and glam on the included stock cooler this time around, and the mounting is arguably far less frustrating than on AMD's RGB LED editions. Simply unscrew the two mounting brackets on the motherboard, leave the stock motherboard backplate in, and secure the cooler in a star pattern with the pre-mounted screws, until you reach the end of the thread — job done. We tied our fan cable into a little loop, to reduce its length and help keep the build looking tidy.

### 4 CABLE CONNECTIONS

Front I/O cables are always going to be a nightmare — fortunately, Gigabyte includes a neat little cradle, where you can preload the cables, then plug the cradle directly into the front I/O connection point, making it easier. We also had to run our front USB 3.0 header down at the bottom of the board here, which proved quite challenging, bending the cable round just enough to mount it. We had little choice on this one, however, because the motherboard itself lacks any USB 3.0 headers near the traditional 24-pin ATX position.



### 5 CABLE MANAGEMENT

We knew from the start that our non-modular PSU was going to cause a few problems. For this build, we installed the PSU, identified how many cables we were going to need, then grouped the remaining ones together, and tied them into little bundles using cable ties, enabling us to tuck them out of the way. Phanteks has also included some of its signature Velcro cable straps in the P300, so you can route your cables however you like, and adjust on the fly, to make sure you can secure that rear side panel.

### 6 SMUDGE-TASTIC

Our only criticism of this chassis is the cutbacks Phanteks had to make when it came to the materials used in its construction. They make sense — after all, to hit such a phenomenally low price point, and still make a profit, compromises have to be made. In this case, the metal finish is prone to fingermarks, as is the glass panel. That said, it's nothing a quick wipe with a microfiber cloth can't fix, and as that's our only gripe with this case, we'll let Phanteks off the hook this time.

1 Tasteful LEDs? Say it isn't so! This tiny LED strip light can be configured by the front I/O, and streaks down the side of the tempered glass panel.

2 The only thing we do wish is that this PSU cover had some cutouts, so the GPU power could run straight through, as opposed to sideways.

3 Adding an additional 120mm fan in the front here would help keep temperatures down immensely, providing cool air to the GPU.

4 You could run an M.2 SSD beneath the GPU, but to avoid thermal throttling, you're better off with the 2.5-inch in the back.

## Red planet

This is one classy machine. It just goes to show how far chassis development has come – the internal layout enables you to keep budget boxes so much tidier nowadays.

All in all, it was a painless build. The only real issue we had was with the hard drive caddy. Why the mounting slots don't match the holes in WD's 2TB Black 3.5-inch drives is beyond us. We got around this, though, by removing the two toolless clips from the caddy, then securing the hard drive in place with screws instead. It was also tricky to install the cables. We actually slid it out the front, installed the cables through the case, then slid it back into the hard drive cage. Having the extra wiggle room outside the chassis made it easier.

We had a slight issue when installing the motherboard, and it was nothing to do with forgetting the rear I/O shield either. Whether it was a cost-cutting measure in the P300, or the B350-Gaming 3's budget sizing, there were no cut-outs to support the extreme right-hand edge of the motherboard. So if you weren't careful, you could accidentally flex the PCB when installing the 24-pin ATX power. To get around this, when installing the big juice, we placed two fingers underneath the edge of the board, before pushing the 24-pin into place. Interestingly, the P300 supports E-ATX boards, but only up to 275mm – impressive nonetheless, and an oddity in an $85 chassis.

On to the nitty gritty: performance. It isn't a bad rig at all. The Ryzen 3 1300X is a potent chip for the price. Desktop performance is smooth as butter, combined with 16GB of DDR4, and that zippy 750 Evo is quick, too, and doesn't bottleneck when running multiple applications. Now, we're not saying you can have 15 Chrome tabs open, VoIP, two games and screen recording on the go, but for everyday usage, office work or more, it hits the spot perfectly. In game, it holds itself steady, hitting 54fps in *The Division* at 1080p, and 30fps in *Rise of the Tomb Raider*, at the nastiest of settings. The RX 570 isn't the most cost-effective card around, we have to admit – and as cryptominers continue to snap up any AMD-branded card, that's unlikely to change anytime soon – but it's no slouch either. Perfect for 1080p gaming.

The upgrade path for this rig is fairly sound. A more powerful processor would be a treat, or to save a bit of cash, you could invest in the cooling, and overclock the 1300X. Higher frequency memory makes a huge difference to Ryzen's performance, too – a 3,200MT/s kit would easily add 10–15% to processing output. Of course, the obvious hit for gamers right now is that Nvidia is far more cost-effective than the AMD alternative.

It's a good rig, for sure, we just wish AMD's VGA division was a little more competitive. ■

### BENCHMARK RESULTS

| | APC LABS TEST PC | THIS SYSTEM |
|---|---|---|
| CINEBENCH R15 MULTI-THREAD | 987 | 543 (-45%) |
| CINEBENCH R15 SINGLE-THREAD | 196 | 137 (-30%) |
| TECHARP'S X264 HD 5.0.1 (FPS) | 21.93 | 12.23 (-44%) |
| CRYSTALDISK QD32 SEQUENTIAL READ (MB/S) | 1,895 | 519 (-73%) |
| CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S) | 949 | 483 (-49%) |
| RISE OF THE TOMB RAIDER (FPS) | 41 | 30 (-27%) |
| THE DIVISION (FPS) | 78 | 54 (-31%) |
| 3DMARK: FIRE STRIKE (INDEX) | 15,026 | 9,772 (-35%) |

Our desktop *APC* Labs' test PC uses a Core i7-6700K CPU @ 4.6GHz, an AMD R9 Fury X, and 32GB of RAM. All games are tested at 1080p on max settings, with HD texture packages installed.

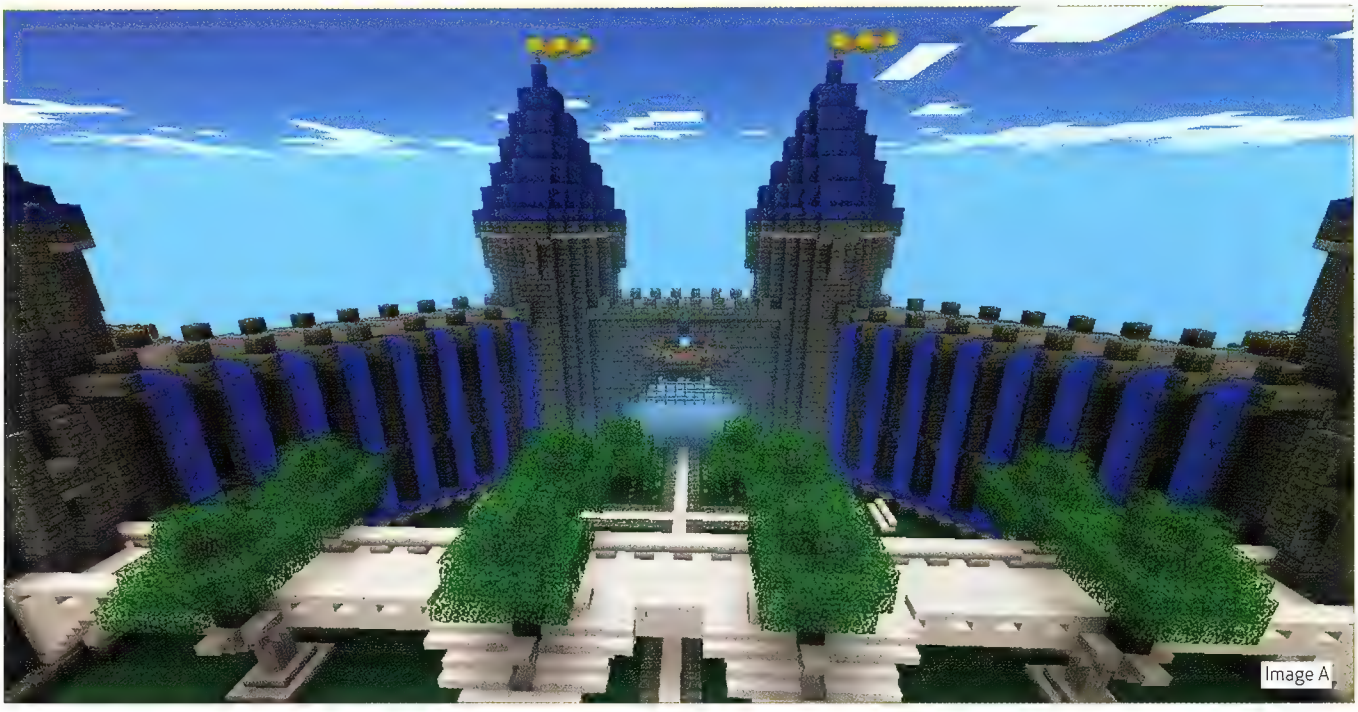


Image A

# Build a world with Minecraft Pi

Join Jonni Bidwell on a trip into the digital sandbox that is *Minecraft* on Raspberry Pi. Here be voxels... and infinite diamonds.

**Besides empowering a new generation of makers, the Raspberry Pi has also established its merits as a gaming platform. Projects such as RetroPie, combined with the Pi's cheapness, mean that it's great for playing old classics. And even some new ones. Such as *Minecraft*.**

In case you've been living under a rock since 2011, *Minecraft* is the best-selling computer game of all time. It's an open-world sandbox affair, in which our hero, Steve, roams around a landscape made of voxels (blocks). Resources can be mined and crafted into other resources, so that Steve can build houses, farm crops, cook food, and fight enemies (all rendered in low-res splendor).

A special version, *Minecraft: Pi Edition*, was released in 2013, and has been bundled with Raspbian since 2014. This version is in some ways cut down, in the sense that there isn't any crafting or baddies, and nor is there any limit on the available resources. But it does have some features that aren't present in the full game, most notably a Python API for manipulating the world while a game is being played. Not having to worry about creatures trying to kill you or where your next meal is coming from makes it great for younger players, emphasising the creative aspects of the game, and the Python API makes it an ideal platform for aspiring coders, young and old.

## 1 FIRST STEPS

To get started, head to the menu, then 'Games > Minecraft Pi'. Choose 'Single Player', then 'New Game'. The game window is offset from the app window behind it – ensure your cursor is parallel with the top of the app window, and hold down to reposition it.

Click 'Start Game', followed by 'Create New'. Your new world now loads. Feel free to explore and build. The controls for the game are pretty simple, and are shown in the table to the right.

Use the mouse to look around you. It can also be used to select items from the inventory. By default, you're holding a sword. Click blocks to destroy them. The sword can also be used to dig. If you select a block from your inventory, you can begin building. Use the right mouse button to place the block, or the left button to destroy it. With time, patience, and some coding to automate block placement, you can have your very own castle **[Image A]**.

## 2 CODING BLOCKS

To start coding in *Minecraft: Pi Edition*, press the Tab key while it's running. Go to 'Menu > Programing'. Click 'Python 3'. Try to place the text boxes so they're next to one another.

You can type commands here to change the in-game world. Over time, you can also write scripts to automate tasks for you – for example, a script that places a stone block wherever you walk. Let's reprogram the game to display a simple message. Type in the following commands, pressing Return after each one:

```
from mcpi.minecraft import Minecraft
mc = Minecraft.create()
mc.postToChat("Hello world, I'm playing Minecraft Pi!!!")
```

Press Return to display your first in-game message. Next, look at the top-left of the screen. You can see your X, Y and Z co-ordinates. This is an excellent way to work out your location, as well as place blocks precisely. You can use Python to summon any number of blocks

### GAME CONTROLS

| KEY | ACTION |
|---|---|
| W | FORWARD |
| A | LEFT |
| S | BACKWARD |
| D | RIGHT |
| E | INVENTORY |
| SPACE | JUMP |
| DOUBLE-SPACE | FLY/FALL |
| ESC | PAUSE/GAME MENU |
| TAB | RELEASE MOUSE CURSOR |

## Install the full *Minecraft* game on the Pi 3

Open Terminal on your Raspberry Pi, and begin by installing some tools:

```
sudo apt-get -y install xcompmgr libgl1-mesa-dri && sudo apt-get -y install libalut0 libalut-dev && sudo apt-get -y install mesa-utils
```

Next, we need to enable an experimental graphics driver. Run `sudo raspi-config` and scroll down to 'Advanced Options'. Press Return. Choose 'AB – GL Driver' and enable it.

Now download the official *Minecraft* client with the following:

```
mkdir ~/Minecraft; mkdir ~/Minecraft/Natives;
cd ~/Minecraft && wget https://s3.amazonaws.com/Minecraft.Download/launcher/Minecraft.jar
```

Launch it by running:

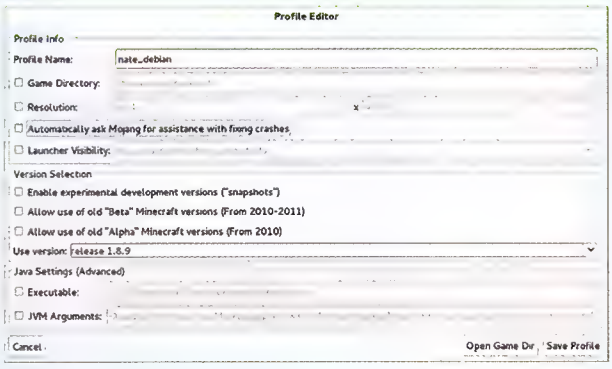
```
$ java -jar Minecraft.jar
```

Now you need to log in with your username and password. Next, click the 'Profile Editor' tab, then click the box that's underneath Version to open up a new window. Find the drop-down menu named 'Use Version' and choose '1.8.9'. Next, click 'Save Profile'.

Click the Play button at the bottom to begin downloading the files. When the downloads are finished, you need to close the launcher and re-open Terminal.

Run the following commands:

```
$ cd ~/Minecraft/Natives && wget https://www.dropbox.com/s/4oxcvz3ky7a3x6f/liblwjgl.so
$ wget https://www.dropbox.com/s/m0r8e01jg2og3bz/libopenal.so
```




```
$ cd /home/pi/.minecraft/libraries/org/lwjgl/lwjgl/lwjgl/2.9.4-nightly-20150209 && rm lwjgl-2.9.4-nightly-20150209.jar
$ wget https://www.dropbox.com/s/mj15sz3bub4dmr6/lwjgl-2.9.4-nightly-20150209.jar

$ cd ~/Minecraft/
$ wget https://www.dropbox.com/s/jkhr58apwa7pt1w/run.sh
$ sudo chmod +x run.sh
```

Next, we need to make some changes to one of the files we've downloaded with the following:

```
$ sudo nano ~/Minecraft/run.sh
```

Scroll down with the arrows, and after the '=' enter your *Minecraft* personal details: email, username, and password. Press Ctrl-X when you're done, then press Y and Return to confirm the changes.

To run *Minecraft* at any time, just enter the following command:

```
cd ~/Minecraft && ./run.sh
```

of various materials. First, let's try placing a single gold block immediately behind you. Type in the following command:

```
x, y, z = mc.player.getPos()
```

You need to run the above command each time you move, to give the game your updated co-ordinates. Press Return, then type:

```
mc.setBlock(x+1, y, z, 41)
```

The number '41' at the end of the last command represents the ID number for gold. Each block or item in the game has a unique ID. If you know the ID of a particular type of block, assign it a name to make it easier to remember. For example:

```
gold=41
```

Press Return, then run these commands to create a giant 10 x 10 x 10 cube of solid gold **[Image B]**:

```
x, y, z = mc.player.getPos()
mc.setBlocks(x+1, y+1, z+1, x+11, y+11, z+11, gold)
```

This is just a small selection of commands that can be run on *Minecraft Pi*. It's also possible to form complex shapes, teleport the player, and even drop blocks as you move around. For a complete list of commands that you can run in *Minecraft: Pi Edition*, as well as the ID numbers for each type of block, head on over to **www.stuffaboutcode.com/p/minecraft-api-reference.html**.

### 3 AVOIDING THE MINEFIELDS

As we've discussed, *Minecraft Pi* is very similar to the *Pocket* edition of *Minecraft*, which can be played on handheld devices such as Android phones and iPhones. It can't interact with people using the official Minecraft client. According to reports on the Mojang website, it appears the client hasn't been updated in a while, but if you simply want to make simple structures and learn to code, without the extra features of the full *Minecraft* client, it's ideal.

Although we've seen it's possible to get the full version of *Minecraft 1.8.9* running on a Raspberry Pi 3 (see the boxout, above), the method isn't officially supported by Mojang. This means that you're likely to see reduced performance compared to a regular desktop machine, including glitches and crashes some of the time.

The experimental graphics driver that has to be enabled on the Raspberry Pi to use the full version of *Minecraft* stops the official *Minecraft Pi* client from working, but you can disable it again by running `sudo raspi-config` and then rebooting the machine.

Neither version of *Minecraft* plays particularly well if you're accessing the Pi over VNC, so it's best to play it directly.

If you wish to play the full version of *Minecraft*, you do need to purchase an account from Mojang (currently priced at US$26.95). If you now have the bug and want to take it further, read on for details of how to set up your own *Minecraft* server on the Pi, and build your own digital world block by block.

### 4 MINECRAFT SERVER

We've so far discussed how to play *Minecraft* directly on the Pi, partly for fun and partly as an introduction to programing with Python. This part of the tutorial concerns installing the *Minecraft* server software on the Raspberry Pi 3. This enables others running the *Minecraft* client on their computers to connect to your own online world and play free from thieves and 'griefers'.

*Minecraft* runs in Java, which is pre-installed in the latest version of Raspbian, meaning it's easier than ever to set up a server. The server has fairly low requirements, but for best performance, we recommend using

a Raspberry Pi 2 or 3. With your Pi in hand and a fresh install of Raspbian, connect to it via SSH. Note that the default username and password are "raspberry" and "pi", respectively. Note your Pi's IP address, you'll need it later.

Next, create a directory for *Minecraft* and open it with the following command:

```
$ mkdir minecraft && cd minecraft
```

Then download the latest version of SpigotMC, a highly customisable and lightweight version of Minecraft Server:

```
$ wget https://hub.spigotmc.org/jenkins/job/BuildTools/lastSuccessfulBuild/artifact/target/BuildTools.jar
```

Next, tell the Pi to start building the server tools:

```
$ java -jar BuildTools.jar
```

Once the process is complete, you'll see a message stating "Saved as spigot-1.x.x.jar", where '1.x.x' is the current version number of Spigot that was downloaded (1.11.2 at the time of writing). Next, start the *Minecraft* server with:

```
$ java -jar -Xms512M -Xmx1008M spigot-1.x.x.jar nogui
```

Again, substitute '1.x.x' with the version number of Spigot. The program tells you that you need to agree to the EULA in order to run the server. To do this, type the following command:

```
$ nano eula.txt
```

Scroll down with your arrow keys and delete the word 'false'. Replace it with 'TRUE'. Press Ctrl-X, then Y and Return to save your changes.

Start the server software again with the same command as before:

```
$ java -jar -Xms512M -Xmx1008M spigot-1.x.x.jar nogui
```

You'll see a message stating "Loading Libraries, please wait..." and some basic information about the game. Note that the default game mode is Survival, and you then see the spawn area loading slowly as a percentage. This may restart a couple of times as various levels are spawned. You'll see a message stating 'Done!' once the process is complete. Now it's time to test your server. Go to a computer with the *Minecraft* client installed, and start the program. On the main screen, choose Multiplayer. Next, click 'Add Server'. Click the box marked 'Server Name' and type a name of your choice – for example, "Pi Minecraft Server." Click the box marked 'Server Address' and enter the IP address of your Pi. Click Done when complete. You should now see the *Minecraft* server listed.

Hover your mouse over it, and click the blue Play button. When the game loads, feel free to wander around a little, and even work through your anger issues by smashing a few blocks to make sure the game responds well. Once you're satisfied, close the *Minecraft* window, and return to your SSH client, which is still connected to the Pi. Type `stop` for the time being to stop the server.

You can type `stop` at any time to halt the server if, for instance, you need to make any changes. In future, if you wish to run the server software, connect to the Pi via SSH, then use the following command:

```
$ cd ~/minecraft && java -jar -Xms512M -Xmx1008M spigot-1.x.x.jar nogui
```

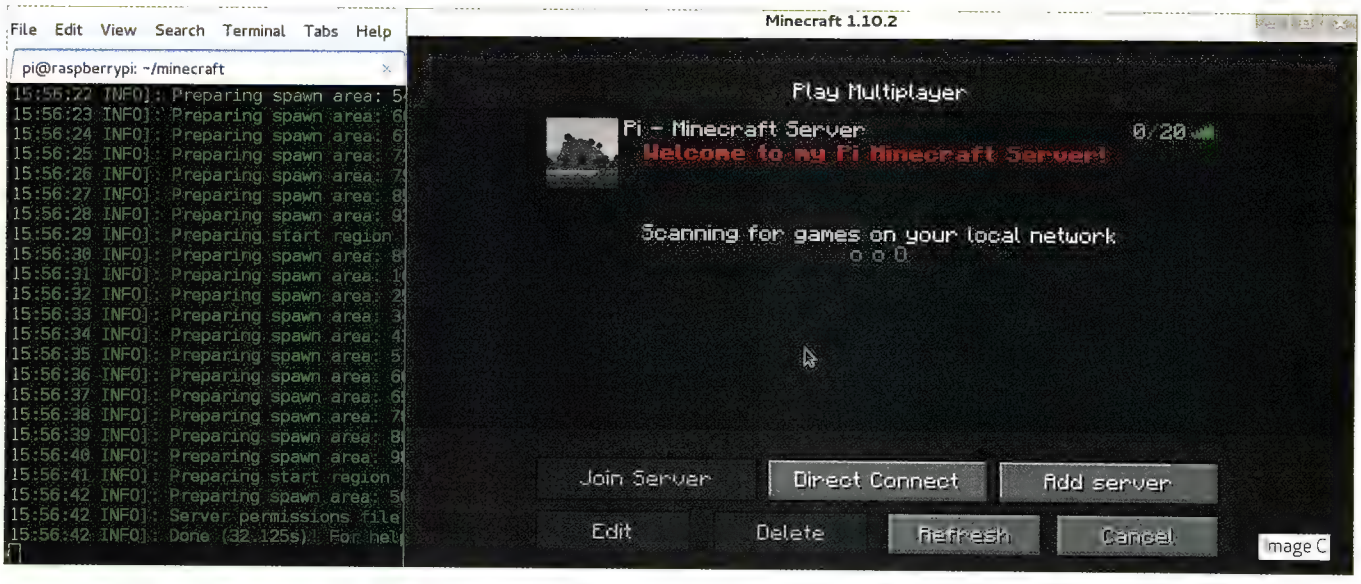
Again, replace '1.x.x' with the actual version number of Spigot you currently have installed. If you're unsure of this, type the command `cd ~/minecraft && ls` to view the contents of the 'minecraft' folder – you can then see the version of spigot-1.x.x.jar in there.

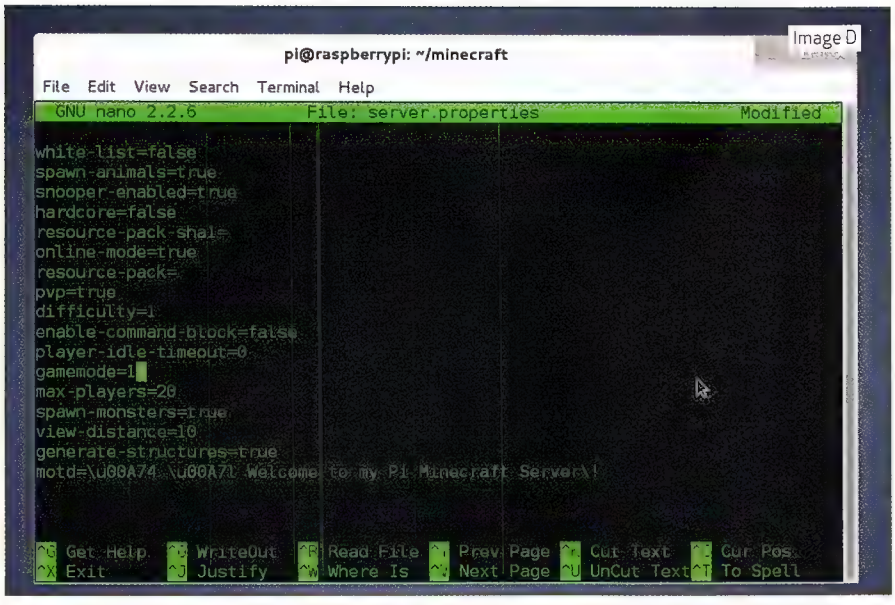
## 5 BASIC SETTINGS

Once the server is up and running, it's time to look at how you can tweak some of the settings. The basic settings are contained in a file named 'server.properties'. You can view and edit this file by running the command:

```
$ cd ~/minecraft && nano server.properties
```

If you're intent on fine-tuning your






*Minecraft* world, visit **minecraft.gamepedia.com/server.properties** to view all values for all potential settings. For now, we're just making some basic changes. Scroll to the very bottom of the file to the value `motd=` using your cursor keys. This is simply the message that appears when you first connect to the *Minecraft* server. By default, this simply says 'A Minecraft server'.

Delete the line of text, and replace it with the following cheery message **[Image C]**:

```
motd=\u00A74 \u00A71 Welcome to my Pi Minecraft Server\!
```

Another change you may want to make to the server – especially for people new to Minecraft – is to change from Survival Mode to Creative. Creative Mode allows for an infinite amount of building materials. Players also don't become hungry or lose energy, so are free to start making their constructs right away.

Scroll up to `gamemode=0` and change the '0' to '1' to do this. Make sure to change 'force-gamemode=false' to 'true', as well, to be certain that everyone who logs on in the future will also be in Creative Mode.

If you're determined to stay in Survival Mode, but want to start off slowly, consider changing 'spawn-monsters=true' to 'false'. You can also change the game's difficulty by changing 'difficulty=1' to a value between 0 and 3, with zero being the easiest difficulty level.

When you are satisfied with the changes you've made, hit Ctrl-X, then Y and Return to save your changes and boot the server.

## 6 ADVANCED TWEAKS

As you become more comfortable with *Minecraft*, or if you're already an experienced player, you may find the basic configuration options in 'server.properties' **[Image D]** limiting. This is where SpigotMC really comes into its own, with an advanced configuration file. There's a number of tweaks to improve your *Minecraft* experience. Simply stop the server, then run the following command:

```
$ cd ~/minecraft && nano spigot.yml
```

By way of an example of how finely tuned Spigot is, scroll down to where it says `zombie-aggressive-towards-villager: true` and change it to 'false'. This setting determines whether or not zombies attempt to kill *Minecraft* villagers. The Pi requires fewer AI resources for 'friendly' zombies, so this may speed up your server. A complete list of the various settings that can be changed in Spigot, along with full descriptions of what they do, can be found at **www.spigotmc.org/wiki/spigot-configuration**.

## 7 SERVER SLOWDOWN

Your configuration may now be tweaked to your heart's content, but as more players join, and more complex structures are created, you may find *Minecraft* slowing down. One way to make sure there is plenty of free space is to move the 'minecraft' folder to an external drive. The syntax of the necessary command is `$ sudo mv ~/minecraft /media/pi/MYUSB`, where MYUSB is the name of your USB stick.

Bear in mind that the above commands for running the software include the cd command, which refers to the 'minecraft' directory in the 'home' folder, so make sure to modify the commands accordingly – `cd ~/minecraft` becomes `cd /media/pi/MYUSB/minecraft`, for example.

If you're still having trouble, try starting the server with the following command which, without going into technical details, instructs Java to make better use of your processor:

```
$ cd ~/minecraft && java -jar
-Xms512M -Xmx1008M
-XX:+UseConcMarkSweepGC
-XX:+UseParNewGC
-XX:+CMSIncrementalPacing
-XX:ParallelGCThreads=2
-XX:+AggressiveOpts -jar
spigot-1.x.x.jar nogui
```

For even better performance, consider editing the 'server.properties' file once again, this time reducing `view-distance` from 10 to 5. This determines how much of the map has to load as you move around. You can also alter `max-players` to change the number of people who can be logged in at the same time.

## Going global with *Minecraft*

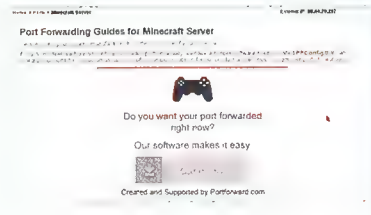
This tutorial explains how to set up *Minecraft* on your local network, meaning anyone who wants to play needs to be connected to it. However, you may wish to allow others to join your server over the internet.

First, you need to assign your Pi a permanent IP address on your network by editing /etc/network/interfaces. Next, use a feature known as port forwarding on your router to forward incoming traffic from the outside Internet to the Pi itself.

Because each router is different, it's best to check the specific steps to do this with your router manufacturer, or enlist a more technically able friend. In either case, say that you need to open port 25565 for both TCP and UDP. You also need your router's external IP address, which you can get by visiting **www.whatismyip.com**.

The Port Forward website has multiple guides for setting up port forwarding: **portforward.com/english/applications/port_forwarding/Minecraft_Server**.

Your ISP may change the IP address of your router from time to time, which could cause difficulties for people playing. You can pay to rent a static IP from your ISP, or get a free one from a service such as **www.noip.com**.


Port Forwarding Guides for Minecraft Server
Do you want your port forwarded right now?
Our software makes it easy
Created and Supported by Portforward.com

# Run Debian Linux on your Android device

With no root-access required, this technique runs Linux on any recent Android device. Darren Yates explains how.

GNURoot Debian works well on our test Motorola Moto G5 phone.

**We all use and love Android – and Oreo/8.0 looks set to make it better still – but if you also need a desktop environment, Android apps can sometimes leave you feeling a bit restricted. Android itself is built on a Linux base, so wouldn't it be great if you could install a Linux desktop OS on your phone or tablet and launch it like an app. Thanks to two free apps you'll find on Google Play, you can – and best of all, unlike many fancy Android tweaks, you don't need to have root access.**

## GNUROOT DEBIAN

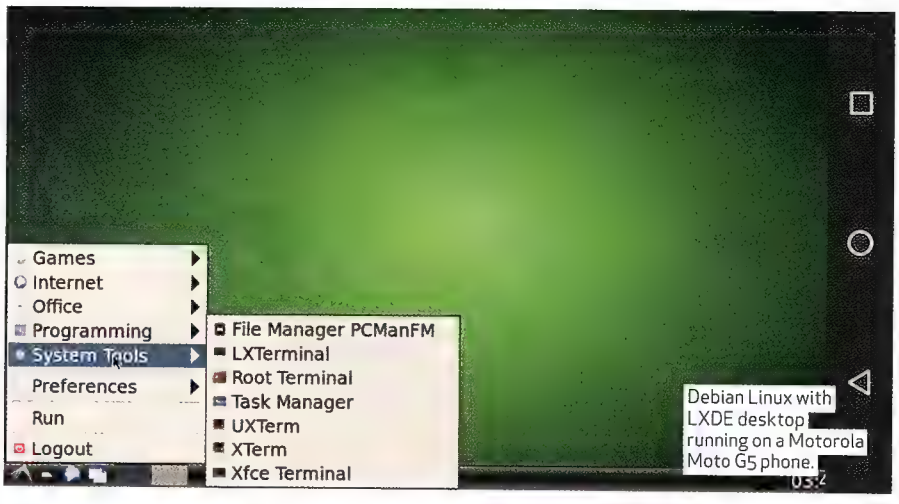
When you install apps on your Android device, they're installed in their own little separate storage space or 'sandbox' to prevent security cross-contamination. The Linux operating system has a similar kind of feature called 'chroot', which allows you to create a 'fake' root folder to build a second independent Linux environment that can only access this alternate path. However, chroot requires root-access, something most Android devices don't usually have. But if Android already installs apps into their own sandbox, do we really need chroot to create another user space?

It turns out the answer is 'no' – clever developers have created a modified version of chroot called 'proot' that creates a similar Linux environment within the confines of a standard Android app sandbox. In other words, we can build a full Linux desktop environment and have it act like an Android app, all without needing root-access. Importantly, in running the Linux code in its own space, it essentially runs as fast as the device CPU allows.

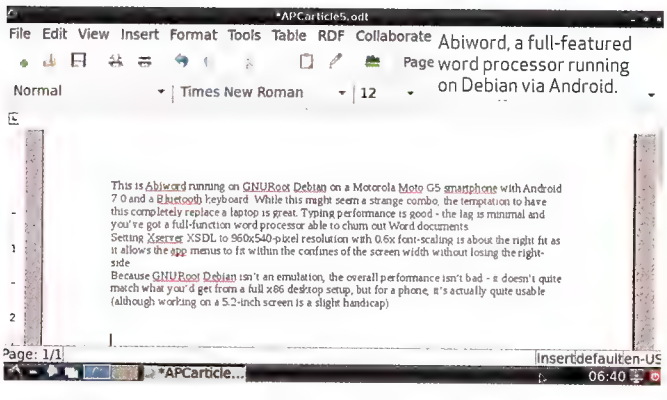
## WHAT YOU'LL NEED

Since you'll be installing a full-on Linux desktop OS here, having a reasonably recent Android device will help – by that, we mean at least 1GB of RAM (preferably 2GB) and at least 16GB of storage (with a good 5–7GB free). If you have a quad-core CPU, bring it along and a physical Bluetooth keyboard and/or mouse wouldn't hurt either. We tested this technique on a Motorola Moto G5 phone, a Samsung Galaxy S3 phone, plus our own cobbled-together dual-core Intel-powered Compaq Presario CQ42 laptop running Android-x86 6.0-r3/Marshmallow and it worked on all three. The app claims to work on Android versions going right back to Froyo/2.2, but realistically, unless you're using Android-x86 on a laptop, it needs to be a device not much more than two or three years old, simply for the processing horsepower.

What's important about this technique is that it doesn't interfere with your ability to run Android apps or anything else to do with your Android OS (other than chewing up RAM and flash storage, obviously). Further, should you need to get rid of the Linux install, just uninstall the GNURoot Debian app and the whole




Debian Linux with LXDE desktop running on a Motorola Moto G5 phone.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File Edit View Insert Format Tools Table RDF Collaborate
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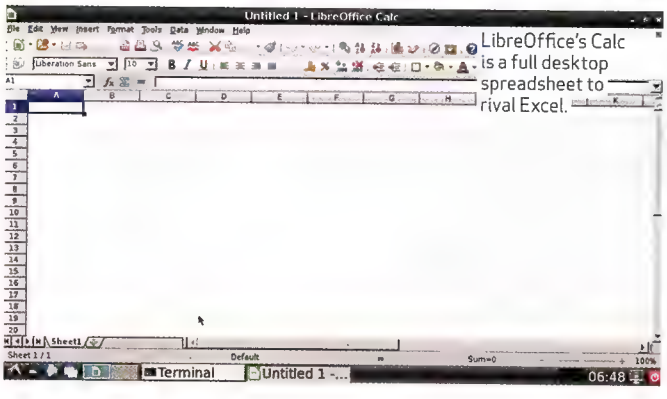
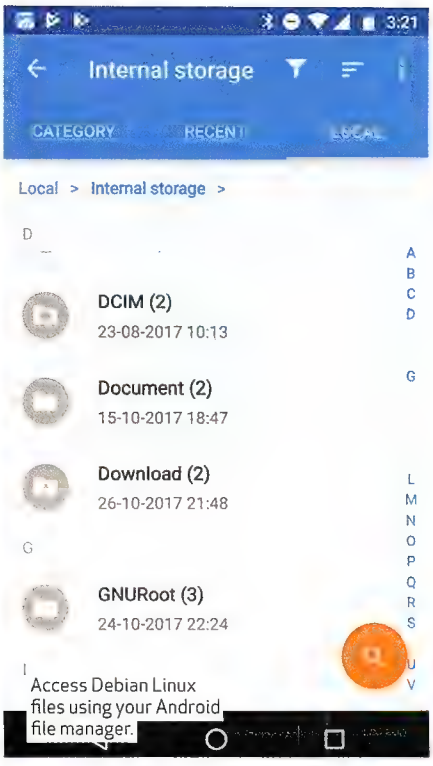
12
This is Abiword running on GNURoot Debian on a Motorola Moto G5 smartphone with Android 7.0 and a Bluetooth keyboard. While this might seem a strange combo, the temptation to have this completely replace a laptop is great. Typing performance is good - the lag is minimal and you're got a full-function word processor able to churn out Word documents.
Setting Xserver XSDL to 960x540-pixel resolution with 0.6x font-scaling is about the right fit as it allows the app menus to fit within the confines of the screen width without losing the right-side.
Because GNURoot Debian isn't an emulation, the overall performance isn't bad - it doesn't quite match what you'd get from a full x86 desktop setup, but for a phone, it's actually quite usable (although working on a 5.2-inch screen is a slight handicap)
Page: 1/1
Insertdefaulten-US
*APCarticle...
06:40

Abiword, a full-featured word processor running on Debian via Android.




LibreOffice's Calc is a full desktop spreadsheet to rival Excel.



Untitled
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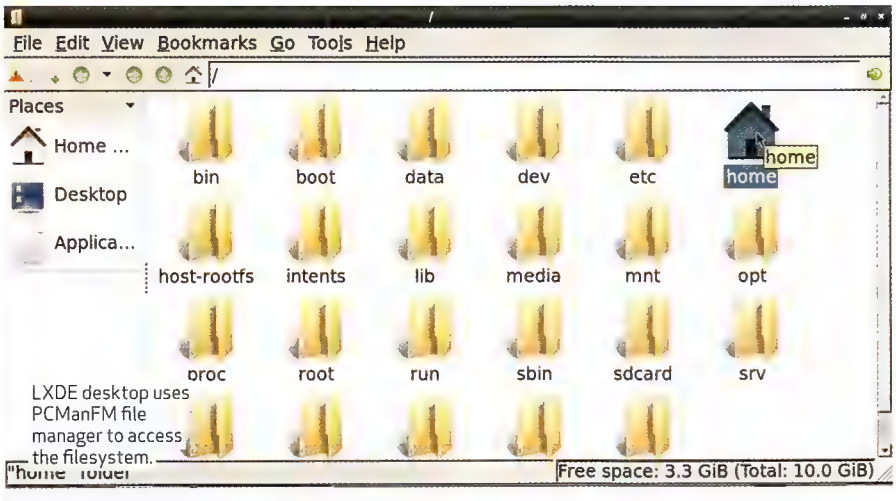
handicap).
Abiword OpenDocument format files load happily into Android's Google Docs.




thing disappears, giving you back your storage.

## SETTING UP DEBIAN

There are various versions of GNURoot available on Google Play, but we recommend the 'GNURoot Debian' version, which automatically sets up a minimal install of the 'Jessie' release of Debian Linux (Debian is the base for many popular Linux distros, including Linux Mint and Ubuntu). You'll find it free on Google Play at **tinyurl.com/zz2lmuu** – since this requires a 60MB download, not to mention the other downloads you'll need, make sure you're hooked up to Wi-Fi rather than your mobile network.

You'll also need a second Google Play app called XServer XSDL (**tinyurl.com/nqyye4s**). Most Linux distros use the X Window System to produce the nuts-and-bolts app windows and desktop graphics. XServer XSDL is an Android implementation of the X Window System and we'll use it here, so install both apps but launch GNURoot Debian first.

On first-launch, GNURoot Debian will race through and unzip the basic environment, taking a minute or two even on a fast device. But to get a full, even lightweight desktop environment created, we'll need to install some extras. Thankfully, GNURoot Debian bakes in access to the Debian repositories, so we can install these extras directly using the Debian command-line 'apt-get' utility.

## UPGRADE & UPDATE

Once unpacked, GNURoot Debian gives you a fake 'root' command prompt or 'shell' environment, so when you're ready, start with:

```
apt-get update
apt-get upgrade
```

As they suggest, these commands update and upgrade the existing minimal Debian environment to the very latest available. The upgrade will likely require roughly 20–25MB of extra downloads via the Debian repositories, which should translate into no more than a few megabytes of extra space.

With that done, you're now ready to install the desktop environment. Because most Android devices run on constrained hardware, we recommend you go for a lightweight desktop environment like LXDE to keep things responsive. My personal favourite option here is Xfce – we installed it, but couldn't get it running in the time available. Still, LXDE is a good default and you can always install utilities from other desktop environments.

Install the core features of LXDE using:

```
apt-get install lxde-core
xfce4-terminal synaptic
pulseaudio
```

This loads up the basic LXDE desktop and adds my favourite terminal app from Xfce, as well as the Synaptic package manager and PulseAudio audio drivers.

Now, this will take some time – anywhere up to an hour or so, depending on your device and broadband connection, so you might want to head out and find yourself a coffee or write a book while you wait. Once complete, launch the XServer XSDL app. On first launch, it gives you the option to download 90MB worth of fonts. You can choose to do nothing and it will first drop you to a black-and-white options-change screen with preset screen resolution and font-scale. Then, after a few seconds, it'll drop another step to a blue 'ready' screen, showing the required hand-over code you'll need to feed GNURoot Debian to get desktop and sound working on XServer XSDL.

For most tablets and laptops, native resolution shouldn't be a problem, but for a phone, particularly a phone with a Full-HD resolution screen, you'll likely end up with a taskbar too small to see.

## FIXING SCREEN RESOLUTION

To fix this, shut down XServer XSDL (you'll find a stop button in the app's entry on Android's status bar list). Launch it again and when that monochrome screen with the resolution and font-scaling numbers appears, tap the screen before the countdown timer runs out and you'll get a screen grid of resolution options.

If you're rocking a phone with a 1,920 x 1,080-pixel display, go for 960 x 540 pixels (top-right), then select the font scale option of '0.6x'. Unfortunately, this font-scale option might be a bit hard to read, but use your judgement, follow the options grid until you get to where '0.6x' should be and tap it (don't worry, fonts will be much clearer when the LXDE desktop appears). After that, you'll move to the blue/white screen with the code required to launch into the X Window System. When you're ready, go back to GNURoot Debian.

For the most part, getting the resolution and font scaling right is a matter of trial-and-error, but a very rough rule-of-thumb is to set XServer to whichever option gives you the closest horizontal resolution to 200 times the diagonal screen size in inches, or alternatively, native resolution, whichever is smaller. Next, set the font scaling to 0.5, 0.6 or 0.7x. That should get you somewhere close to the right mark and you can trial-and-error it from there.

## LAUNCHING LXDE

For this to all work, GNURoot Debian has to set the display port, which automatically routes the desktop vision through XServer XSDL. After that, we can launch the LXDE desktop environment. To do this, run the following two commands:

```
export DISPLAY=:0 PULSE_
SERVER=tcp:127.0.0.1:4712
startlxde &
```

That ampersand '&' is important, so don't leave it out – otherwise, you won't get GNURoot's terminal prompt back. Once those commands are executed error-free, switch back to XServer XSDL and, within a few seconds, the LXDE desktop should begin appearing. Realistically, you'll need at least a Bluetooth keyboard and maybe even a mouse to drive it, but its overall, performance is pretty decent on good hardware.

Logitech's K480 Bluetooth keyboard includes a mobile device stand.

## STORAGE USE

A basic Debian/LXDE setup requires roughly 1.2–1.4GB of device storage on a typical Android (ARM-powered) phone. That will give you a minimal LXDE desktop environment and a few utility apps. All Debian-based Linux distros have at least two methods for installing apps from the Debian app repositories – the command-line 'apt-get' utility if you know the metafile or repository package name for the app you want to install, or you can just launch Synaptic, which will give you a graphical user interface (GUI) for much the same thing. Adding extra apps obviously begins eating up more of your device storage, which is why we suggest having at least 5–7GB of free space before you begin. To add in the full LXDE desktop, use the command:

```
apt-get install lxde
```

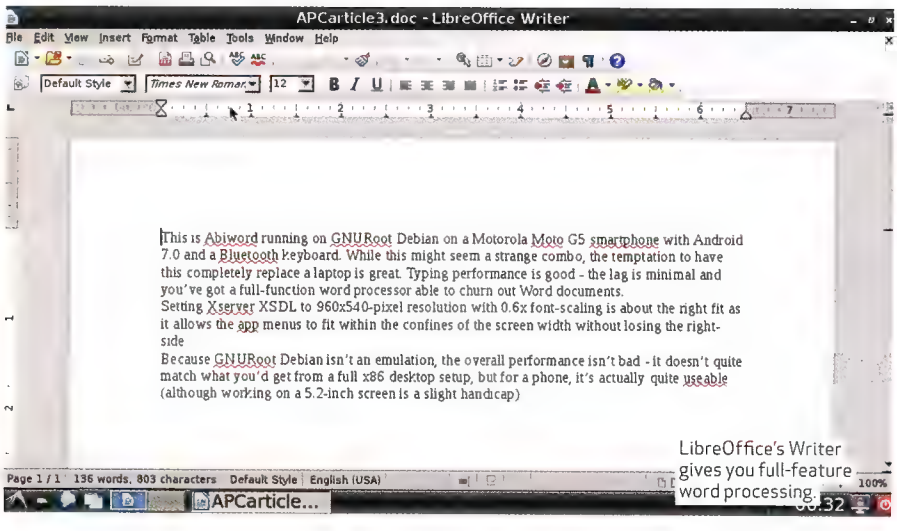
This requires approximately an extra 120MB of downloads and around 300MB of extra storage. Personally, I don't think it's necessary – the green textured background image you can see here on our test build came from the 'gnome-backgrounds' library. You can install this using:

```
apt-get install gnome-
backgrounds
```

Once installed, go to the LXDE desktop and from the menu, select 'Preferences > Desktop Preferences' and tap on the option next to Wallpaper. Navigate to the /user/share/backgrounds/gnome folder and choose your favourite JPEG image. Tap on the Close button and the desktop background image should change appropriately. The gnome-backgrounds library is roughly 12MB or so.

## WHAT WORKS, WHAT DOESN'T

So what works and what doesn't work? In short, not every app in the Debian repositories will work in a GNURoot/XServer XSDL combo – but unfortunately, despite claims to the contrary, one of the apps that didn't work for us was the Firefox-ESR web browser. The 'ESR' is 'extended support release', so it's like Ubuntu's LTS 'long-term support' versions of Linux, not that it matters all that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Page 1 / 1
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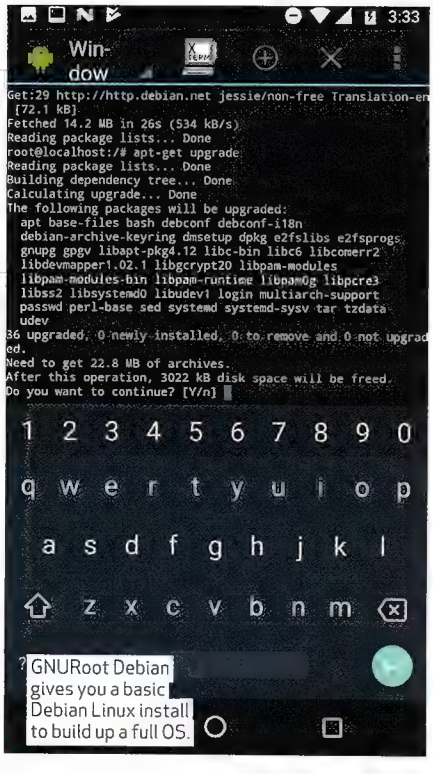
LibreOffice's Writer gives you full-feature word processing.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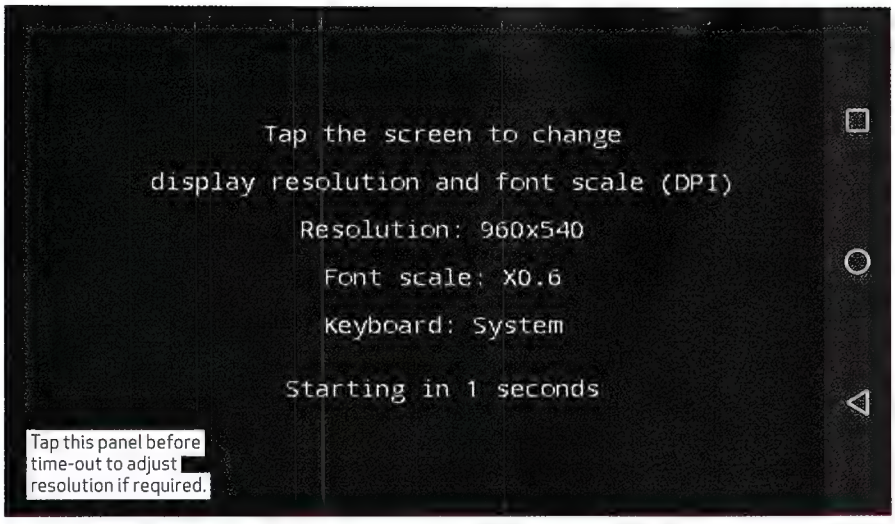
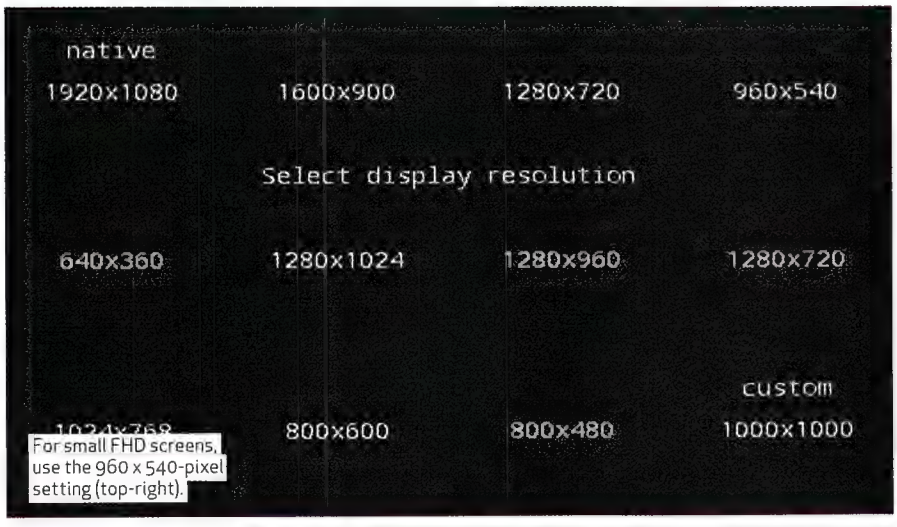
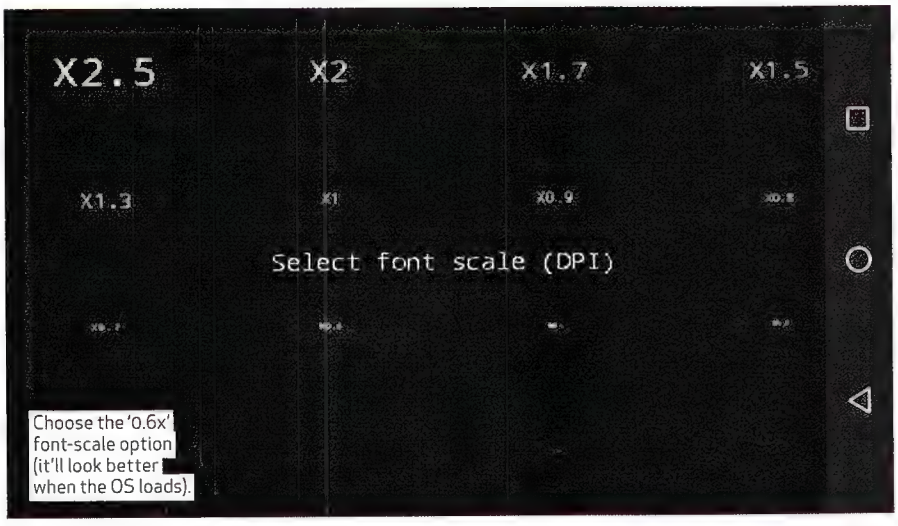
Win-
dow
Get:29 http://http.debian.net jessie/non-free Translation-en
[72.1 kB]
Fetched 14.2 MB in 26s (534 kB/s)
Reading package lists... Done
root@localhost:/# apt-get upgrade
Reading package lists... Done
Building dependency tree... Done
Calculating upgrade... Done
The following packages will be upgraded:
apt base-files bash debconf debconf-i18n
debian-archive-keyring dmsetup dpkg e2fslibs e2fsprogs
gnupg gpgv libapt-pkg4.12 libc-bin libc6 libcomerr2
libdevmapper1.02.1 libgcrypt20 libpam-modules
libpam-modules-bin libpam-runtime libpam0g libpcre3
libss2 libsystemd0 libudev1 login multiarch-support
passwd perl-base sed systemd systemd-sysv tar tzdata
udev
36 upgraded, 0 newly installed, 0 to remove and 0 not upgrad
ed.
Need to get 22.8 MB of archives.
After this operation, 3022 kB disk space will be freed.
Do you want to continue? [Y/n]
1 2 3 4 5 6 7 8 9 0
q w e r t y u i o p
a s d f g h j k l
z x c v b n m
GNURoot Debian gives you a basic Debian Linux install to build up a full OS.




Tap this panel before time-out to adjust resolution if required.




For small FHD screens, use the 960 x 540-pixel setting (top-right).




Choose the '0.6x' font-scale option (it'll look better when the OS loads).

much for us because it didn't work – the app launches on all three test builds, but every webpage is just a white screen. The open-source version of Google's Chrome browser, Chromium, also didn't work – but it wouldn't even start. Some users have reported Firefox-ESR works, just as others have copped the white-screen issue.

Gaming is another mixed bag – XServer XSDL doesn't support OpenGL or any 3D acceleration, so that knocks out a fair chunk of more advanced games. That said, most 2D-style games including retro platformers and card games should run (we had Airstrike running reasonably well). But really, if you want games, head back to Android and go to town.

To be fair, the developer behind GNURoot Debian is clear that it's not a finished app, so bugs and issues are always possible. OpenGL-based apps will require an X server with OpenGL support – probably best not to hold your breath for that one.

But all that said, there are still plenty of apps that do work – for example, the lightweight full-function word processor Abiword worked, so too did LibreOffice, the offshoot of OpenOffice. We also had The GIMP image editor, Inkscape desktop publishing and IDLE, the Python 3.4 development app, all working a treat.

The most surprising thing for me about GNURoot Debian is the speed – if you tried using Linux via a virtualisation layer on smartphone-grade hardware, you'd expect to be here all day waiting for it to load. The LXDE desktop via GNURoot loads up surprisingly fast and apps are quite responsive. As a productivity option, GNURoot Debian has potential.

## ACCESSING FILES

However, having access to two OS environments is really only useful if you can easily transfer files between them. Thankfully, you can – while Debian Linux installs into its own root file system, you can access that filesystem from within Android. Just open up your device's default Android file manager, head into the local/internal storage folder and select the 'GNURoot' folder. Open up the 'home' subfolder and this corresponds to the '/home' folder in your GNURoot Debian install. Any files you create and store in that /home folder can be access by either Android or your Debian Linux install. However, since Debian exists in its own root filesystem, it shouldn't be able to access any other folders within your Android device.

For example, install LibreOffice, create an open-document format (.odt) file here, save it in your /home subfolder and you'll be able to open it up in Google Docs in Android.

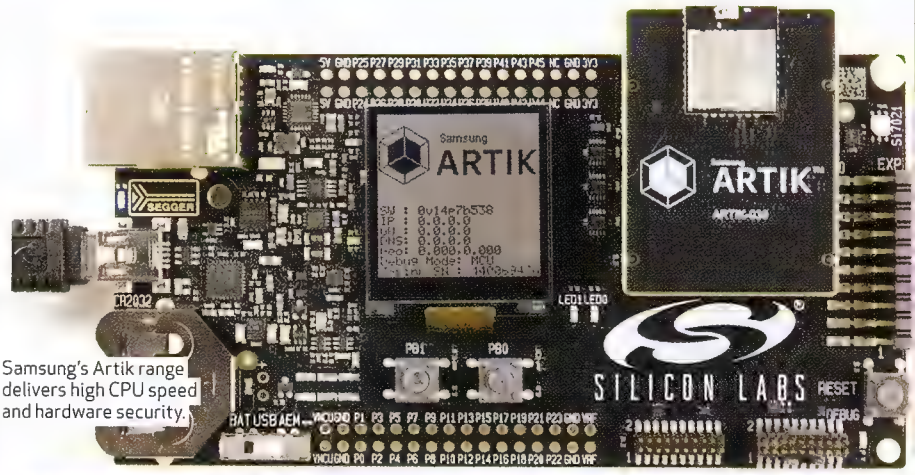
## TRY IT YOURSELF

So is it time to ditch the laptop and live the desktop life on your phone or tablet? Probably not, but for some users at least, it might well be worth a look. Yes, the need for at least a Bluetooth keyboard means you may still have to carry some extras around with you, but given how little a Bluetooth keyboard weighs (and how small some of them are), this is probably the smallest, most portable way to take a desktop with you.

# Ten 32-bit maker boards

The maker market is awash with high-performance maker boards, with more on the way. Darren Yates looks at ten options that go way beyond the Arduino Uno.

**The Arduino Uno and Nano boards are incredibly popular, easy to use and surprisingly robust. They may not be endowed with lashings of performance, but they come with an excellent array of I/O ports and functions to make it easy to connect up almost anything. Yet eventually, that 8-bit performance becomes a road block, and if you're in need of more speed, there are plenty of options that leave those 8-bit Arduino boards behind.**




Samsung's Artik range delivers high CPU speed and hardware security.

## ARDUINO M0

While there are plenty of designs around, the original Arduino Uno form factor is pretty close to universal and tough to beat. The new Arduino M0 ups the ante with a 32-bit 48MHz Atmel SAMD21 Cortex-M0 microcontroller with 32KB of RAM and 256KB of flash storage, well ahead of the original Uno and Nano boards. However, like all other 32-bit boards, the M0 runs off 3.3VDC, using a voltage regulator to turn the USB's 5VDC into 3.3V. That means many Arduino Uno-style shield boards aren't likely to work here. Still, you're getting considerably more horsepower for your money and it still programs via the standard Arduino IDE. The genuine article will set you back about $40, but you'll also find M0 clones available on eBay for around $15–$20 (**tinyurl.com/yaf3qeya**).

## ARDUINO MKR GSM 1400

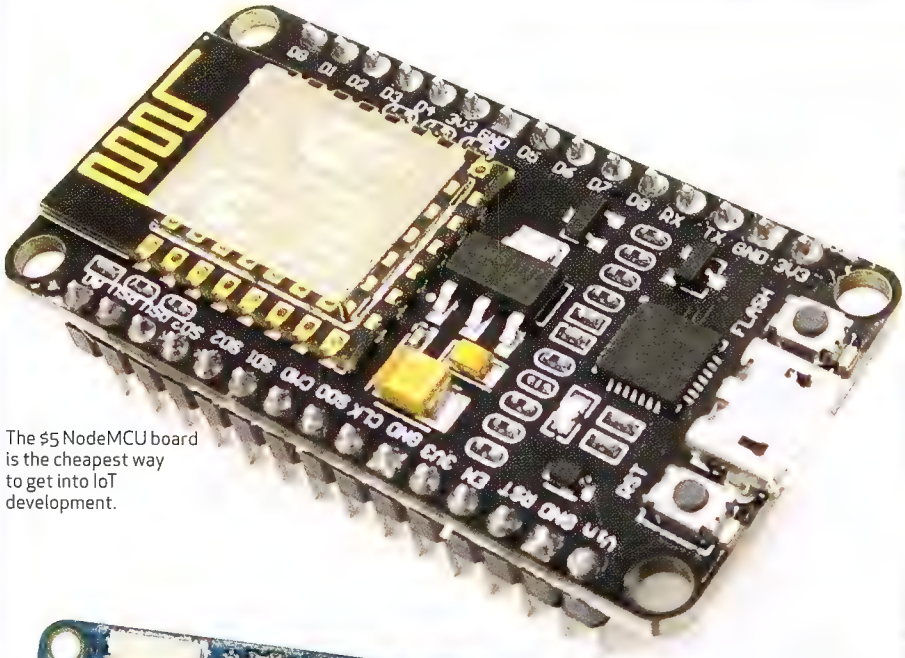
Despite all else, Arduino is still the first name most makers hear and the brand is creating a new series of MKR-family boards focusing on compact design and, increasingly, wireless communications. The brand-new MKR GSM 1400 is a slim board incorporating a global 3G mobile network module on top and a SIM card slot underneath. It's powered by the same 48MHz Microchip SAMD21 ARM Cortex-M0 microcontroller inside the Arduino M0 and has a range of extras, including 12-bit ADC and 10-bit DAC. It can also be powered by a single-cell Lithium-polymer battery – in fact, you must provide one if you're using the 3G mobile. The 3G power demands exceed standard USB power, so the battery has to supply the peak. What's great about it, though, is the GSM 1400 appears to have on-board hardware to charge the battery via USB. Even better, you still program it via the standard Arduino IDE. If you have a project idea needing 3G comms, start here – it'll be available mid-November 2017 (**tinyurl.com/ybm9t92t**).

"They may not be endowed with lashings of performance, but they come with an excellent array of I/O ports and functions to make it easy to connect up almost anything."

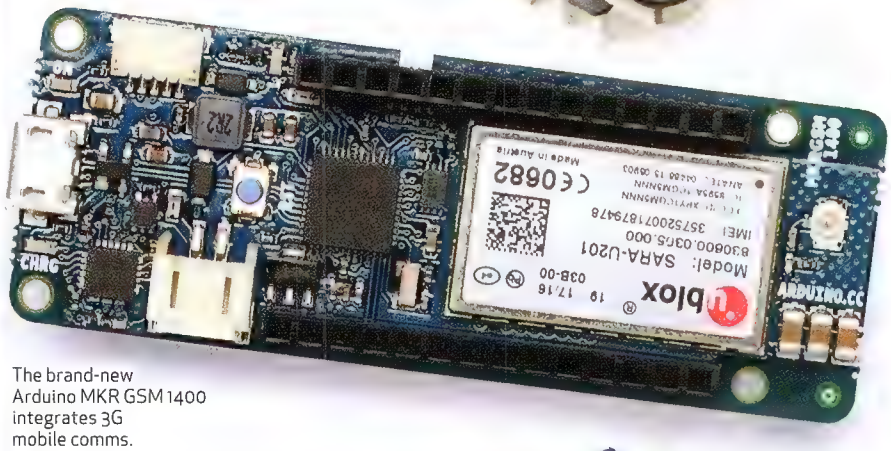
The Arduino M0 adds a 32-bit chip to the Arduino Uno form factor.

## ARDUINO MKR ZERO

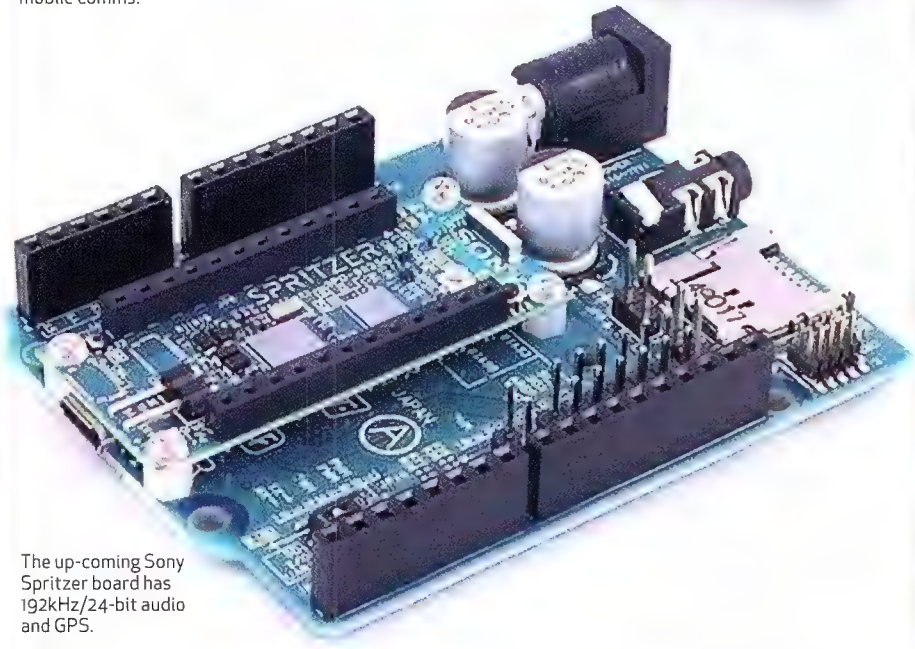
Arduino's new MKR series is gaining plenty of traction, thanks to its combination of 32-bit performance in a skinny Arduino Nano-like form-factor. The MKR Zero is essentially the MKR GSM 1400 without the 'GSM' bit, meaning no 3G connectivity, but you get the same 48MHz Atmel SAMD21 microcontroller. What's more, the MKR Zero features on-board circuitry for charging LiPo batteries, plus a microSD card reader. Throw in an on-board single-channel 10-bit DAC, the downloadable Arduino Sound library and you can get the MKR Zero playing back your PCM WAV audio files with relative ease. It also has an I2S bus to connect up external audio decoding chips. Along with the Arduino M0, this is now the cheapest of the official



The $5 NodeMCU board is the cheapest way to get into IoT development.



The brand-new Arduino MKR GSM 1400 integrates 3G mobile comms.



The up-coming Sony Spritzer board has 192kHz/24-bit audio and GPS.

32-bit Arduino boards. Unofficially, you'll find M0 clones on eBay for around US$15 (**tinyurl.com/y7qxaphq**).

## ESP-32S

Espressif Systems set the world alight a couple of years ago when it launched its ultra-budget 802.11n Wi-Fi microcontroller called the ESP8266. It has now followed up with the ESP-32S, which is basically a double ESP8266 with added Bluetooth. It's powered by a dual-core Xtensa LX6 32-bit design that can hit 160MHz in dual-core mode or 240MHz running as a single-core only. Throw in 520KB of RAM, 4MB of flash storage, plus 2.4GHz 802.11b/g/n Wi-Fi, Bluetooth 4.2/BLE and it really is an impressive little chip. Breadboard-friendly versions are already available for around the $10 mark on eBay that power via USB and there's patch software to enable it to be coded via the Arduino IDE. Right now, you won't find a cheaper Wi-Fi/Bluetooth-combo ready board than this.

## NODEMCU/ESP8266

Before Espressif Systems launched the ESP8266, making Internet of Things (IoT) gadgets was an expensive hobby. But its arrival meant not only could you add Wi-Fi to your Arduino projects for under $10, you could even code the ESP8266 itself and ditch the Arduino board altogether. The budget $5 NodeMCU boards are essentially that – a CH340G USB connectivity chip and the ESP8266, which itself is an excellent little 32-bit microcontroller. It features an 80MHz single-core Tensilica Xtensa core with 64KB of RAM and up to 512MB of flash storage. It's even possible to load up a MicroPython ROM and use Python to code your projects. Be aware that the latest 'V3' boards use up the full depth of a standard breadboard and you need to route connecting wires under the board itself – annoying, which is why the older 'V2' is the better option if you can still find it. These NodeMCU boards were originally designed for the Lua programming language, but you can now code them with the standard Arduino IDE.

## STM32F103 MINI

Built around a 72MHz STMicro STM32F103C8T6 Cortex-M3 microcontroller, this tiny board goes for under $4 on eBay and is sold by the busload. It's loosely based on a similar board called the 'Maple Mini', originally designed by US tech firm Leaf Labs, which has since made the design open source. The STM32F103C8T6 chip offers 20KB of RAM (10 times that of the Arduino Uno and Nano boards) and 64KB of flash storage (twice that of the Uno/Nano). All I/O pins and the chip itself run off 3.3VDC, rather than the Uno/Nano's 5VDC. It initially needs an ST-LINK USB adapter to connect to your PC, but you can program it via the Arduino IDE using details available from the Arduino for STM32 website (**stm32duino.com**). The STM32F103 chip contains an ARM Cortex-M3 core – your phone will likely have at least one of these doing something somewhere.

## STM32F407VE BOARD

But if a Cortex-M3 isn't enough, the next step is the more powerful ARM Cortex-M4 inside the STM32F407VE microcontroller. It cranks along at 168MHz and includes 192KB of RAM and 512KB of flash storage. The chip features a genuine SDIO (Secure Digital Input/Output) bus for running MicroSD cards at high speed, not to mention three 12-bit analog-to-digital converters (ADCs) and two 12-bit digital-to-analog converters (DACs). Again, this is not a genuine Arduino-supported board; however, the excellent community over at Arduino for STM32 (**stm32duino.com**) is working on making

library patches for these boards to get them linking into the Arduino IDE. Generic versions, some of which include microSD card reader, sell on eBay for as little as $15. They're similar to, but not quite as fast as the Teensy 3.6 (see below).

## SAMSUNG ARTIK

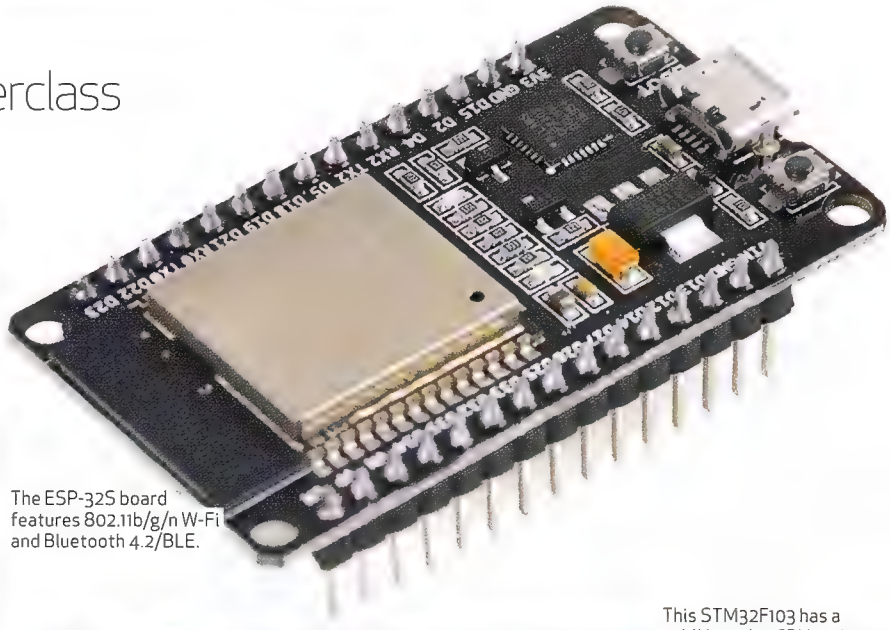
Samsung's Artik range of boards are specifically designed for the Internet of Things market, but also come with Raspberry Pi-levels of horsepower. For example, the Artik 530 has a quad-core Cortex-A9 processor (similar to a Samsung Galaxy S3 smartphone), 512MB of RAM and 4GB of eMMC flash storage. Prototyping boards here start at around US$100 for an Artik 20, while the Artik 530 will set you back about US$200. One of Samsung's major focuses with these boards is security, which isn't a bad thing. IoT devices in general have copped plenty of flak in recent times over inadequate security measures, but features such as Secure Boot and cloud authentication should help these Artik boards stand up in the face of online threats (**www.artik.io**).

## SONY SPRITZER

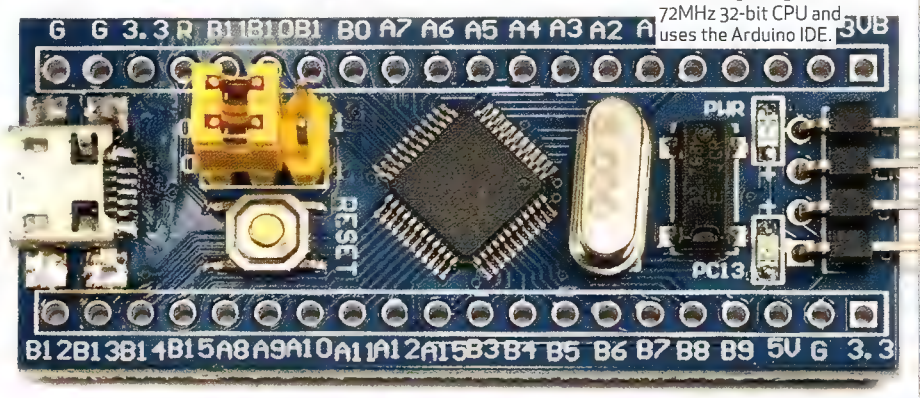
Yep, you read that right – Sony is set to jump into the maker market with its own Arduino-compatible board. The Spritzer, which has the same form factor as the Arduino Uno, was first previewed at Maker Faire Tokyo in August and plans are for it to be available in early 2018. If you have a high-performance IoT project in mind that needs plenty of RAM, this could be the board for you – a six-core Sony CXD5602 ARM Cortex-M4F CPU clocking at up to 156MHz with 1.5MB of RAM and 8MB of flash. While you're at it, throw in integrated GPS. However, audio makers will love the specs on this one – unlike most boards, the Spritzer packs in a CXD5247 audio codec chip with support for up to eight digital and four analog mic inputs, plus two audio output channels. It'll even deliver up to 192kHz/24-bit audio. At this stage, there are no pricing details, but we suspect it won't come cheap. Mind you, there aren't many boards quite like it (**tinyurl.com/yakluk6k**).

## TEENSY 3.6

You know the maker market has gone mainstream when you can buy microcontroller boards from Kogan. It seems Kogan's purchase of Dick Smith has seen it unleash its inner maker, selling this Teensy 3.6 and other maker boards. The Teensy range is well regarded by makers and the Teensy 3.6 is about as much computer power as you can fit onto a single breadboard. It's powered by a 180MHz Freescale MK66FX1M0 ARM Cortex-M4 core, overclockable to 240MHz, with 256KB of RAM and 1MB of flash storage. There's no wireless connectivity on this one, but it does feature two 12-bit ADCs and two 12-bit DACs, plus a swag of interconnects including SPI, I2C and Ethernet. You can also download add-on software that hooks it up to the standard Arduino IDE.



The ESP-32S board features 802.11b/g/n W-Fi and Bluetooth 4.2/BLE.



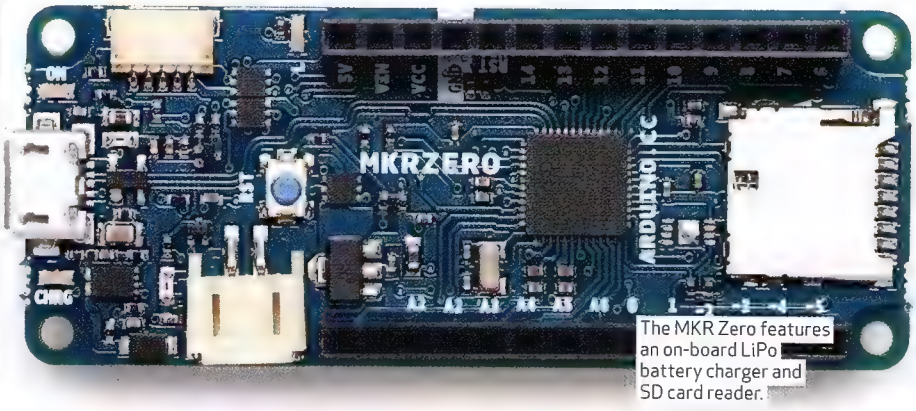

This STM32F103 has a 72MHz 32-bit CPU and uses the Arduino IDE.

> "The Raspberry Pi has conquered all-comers, but not every project requires an HDMI output or desktop operating system – that's where the efficiency of 'bare-metal' coding comes into its own."

## MAKE SOMETHING

The Raspberry Pi has conquered all-comers, but not every project requires an HDMI output or desktop operating system – that's where the efficiency of 'bare-metal' coding comes into its own. Really, this is such a rich time in history to make your own tech gear – Tommy Flowers, Alan Blumlein and Alan Turing would go nuts at the tech we have available today.

The combination of low-cost processing and ubiquitous wireless means you don't have to wait for the IoT market to swing by with the gadget you need – you can make it yourself!




The MKR Zero features an on-board LiPo battery charger and SD card reader.

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# Spending your inheritance

Darren Yates shows how Python tackles the complex but valuable concepts of inheritance and polymorphism.

**They're no doubt two of the more difficult programming concepts to get your head around, but inheritance and polymorphism are integral to maximising the value you get from using classes. They help simplify your code, but also give you the option of customising it at the same time to meet the specific needs of your programming tasks.**

Python not only supports these features, but does so in a way that's easy to implement and understand.

## CLASSES OVERVIEW

These new concepts build on the idea of 'classes' that we looked at last month. Just to review quickly, a class is a code block that describes an object and how it works through data attributes (or variables) and functions. What's more, a class is typically used like a 'cookie-cutter' to quickly create new copies. We looked at the idea of a smartphone being an object with common features, from screen size, operating system, RAM, flash storage, CPU and so on. But rather than creating a new set of variables and functions for every smartphone object we want to create, we create a 'smartphone' class and use it like a cookie-cutter to stamp out class copies or 'instances' of that 'smartphone' class. For example, you don't need separate variable definitions to describe a Motorola Moto G5 or a Samsung Galaxy S8 – you just create two instances of the 'smartphone' class and those variables (and whatever functions the class has) are generated automatically, then populated by your code with the attributes of each phone.

Two of the many benefits of doing this are that it, first, helps you standardise on the data attributes you need to define a smartphone, but also, second, it helps reduce the opportunity for introducing errors, by standardising those attributes with a constant name and type – not to mention writing less code, which is always a good thing.

## CLAIMING YOUR INHERITANCE

Inheritance takes building classes a step further. Smartphones are pretty cool, but they're also specialised versions of computers, so you could say 'a smartphone is a computer' (something we've been saying for years!). This 'is a' relationship between objects, where the smartphone is a more specific version of a computer, can be used in creating classes. Instead of building separate classes for 'smartphone' and 'computer', the fact that a smartphone is a type of computer means that we can create a parent or 'super'-class called 'computer' and derive a child or 'sub'-class called 'smartphone' from the computer superclass. The important part of this is that the smartphone subclass gains or 'inherits' all of the attributes and functions of its computer superclass.

## HOW IT WORKS

Grab this month's Python source code pack from our website (**apcmag.com/magstuff**) and open up 'computer.py' in Python's IDLE editor. (Don't have Python? Grab the latest version 3 release for your preferred OS from **www.python.org/downloads**.) The file doesn't do anything in particular, other than define the class called 'computer'. The first function defined is the initialisation function, which expects a series of parameters 'brand', 'model', 'cpu' and so on (remember, the 'self' parameter refers to the class instance itself). Each of the parameters inside the brackets is then assigned to the appropriate attribute or internal variable (the double underscore '__' ensures the variable can't be accessed outside of the class boundary).

After that, the remaining functions are colloquially known as 'setters' (setting a class attribute value) and 'getters' (getting a class attribute value). So, basically, the 'computer.py' file defines the 'Computer' class.

Now open up 'smartphone.py'. This one's a bit more interesting – first up, we import the Computer class from the 'computer.py' file (provided the imported file is in the same filepath as your source code, referencing just the name of the file is fine). Next, we define a new class called 'Smartphone', however, inside the brackets is a reference to the 'Computer' class in the 'computer.py' file. This means we want to create a new subclass called 'Smartphone' based on the superclass 'Computer'.

We follow this up with defining the initialisation function as we did with the Computer class, but this time, we include all the parameters required for the Computer class as well as the parameters

```
class Computer:
    def __init__(self, cpu):
        self.__cpu = cpu

    def get_cpu(self):
        return self.__cpu

    def set_cpu(self, cpu):
        self.__cpu = cpu

    def print_specs(self):
        print("CPU: "+self.get_cpu()+" processor")

class Smartphone(Computer):
    def __init__(self, cpu):
        Computer.__init__(self,cpu)
        self.__cpu = cpu

    def print_specs(self):
        print("SoC: "+self.get_cpu()+" SoC")

def main():
    hpx360 = Computer("Intel Core i5-3210U")
    hpx360.print_specs()
    motog5 = Smartphone("Qualcomm Snapdragon 430")
    motog5.print_specs()

main()
```

Polymorphism allows a subclass to override a superclass function.

```
class Computer:
    def __init__(self, brand, model, cpu, ramgb, os, price):
        self.__brand = brand
        self.__model = model
        self.__cpu = cpu
        self.__ramgb = ramgb
        self.__os = os
        self.__price = price

    def set_brand(self, brand):
        self.__brand = brand

    def set_model(self, model):
        self.__model = model

    def set_cpu(self, cpu):
        self.__cpu = cpu

    def set_ramgb(self, ramgb):
        self.__ramgb = ramgb

    def set_os(self, os):
        self.__os = os

    def set_price(self, price):
        self.__price = price

    def get_brand(self):
        return self.__brand

    def get_model(self):
        return self.__model
```

A class lets you define an object by creating variables and functions.

```
Python 3.6.1 Shell
File  Edit  Shell  Debug  Options  Window  Help
Python 3.6.1 (v3.6.1:69c0db5, Mar 21 2017, 17:54:52) [MSC v.1900 32 bit (Intel)]
 on win32
Type "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: C:\Users\Darren\Python Code\Python_EP_18\comp2.py ==========
CPU: Intel Core i5-3210U processor
SoC: Qualcomm Snapdragon 430 SoC
>>>
```

The output of comp2.py shows the print_specs() override results.

Ln: 7 Col: 4

"We're defining the Smartphone class by using the Computer class as a base and then adding in the extra features..."

```
Python 3.6.1 Shell
File  Edit  Shell  Debug  Options  Window  Help
Python 3.6.1 (v3.6.1:69c0db5, Mar 21 2017, 17:54:52) [MSC v.1900 32 bit (Intel)]
 on win32
Type "copyright", "credits" or "license()" for more information.
>>>
====== RESTART: C:/Users/Darren/Python Code/Python_EP_18/smartphone.py ======

Brand       : Motorola
Model       : Moto G5
CPU         : Qualcomm Snapdragon 430
RAM         : 2GB
OS          : Android 7.0
Screen size: 5.0inches
Battery cap: 2800mAh
Price       : $299

Brand       : Samsung
Model       : Galaxy S8
CPU         : Qualcomm Snapdragon 835
RAM         : 4GB
OS          : Android 7.0
Screen size: 5.8inches
Battery cap: 3000mAh
Price       : $849
>>>
```

Output of the Smartphone class instances that inherit from Computer.

Ln: 23 Col: 4

```
smartphone.py - C:/Users/Darren/Python Code/Python_EP_18/smartphone.py (3.6.1)
File  Edit  Format  Run  Options  Window  Help
def main():
    motog5 = Smartphone('Motorola', 'Moto G5', 'Qualcomm Snapdragon 430', 2, \
                        'Android 7.0', 299, 5.0, 2800)
    gals8 = Smartphone('Samsung', 'Galaxy S8', 'Qualcomm Snapdragon 835', 4, \
                       'Android 7.0', 849, 5.8, 3000)
    print_specs(motog5)
    print_specs(gals8)

def print_specs(phone):
    print("\nBrand      :", phone.get_brand())
    print("Model      :", phone.get_model())
    print("CPU        :", phone.get_cpu())
    print("RAM        :", str(phone.get_ramgb())+"GB")
    print("OS         :", phone.get_os())
    print("Screen size:", str(phone.get_screensize())+"inches")
    print("Battery cap:", str(phone.get_batterycap())+"mAh")
    print("Price      :", '$'+str(phone.get_price()))

main()
```

The Smartphone subclass inherits functions from the Computer class.

Ln: 17 Col: 32

required by the Smartphone class. Those Computer class parameters are then passed onto the Computer class through the Computer initialisation function. After that, we assigned the screen size and battery capacity parameters to variables of the Smartphone class. If that doesn't make sense, we'll put it another way – we're defining the Smartphone class by using the Computer class as a base and then adding in the extra features (screen size and battery capacity) that are specific to the Smartphone class.

The 'smartphone.py' file follows on with a main() function and here, we put these classes to work by creating two Smartphone-class instances – 'motog5' and 'gals8', each with their appropriate attribute or parameter values. The last two lines in the main() function print these values to the screen using the 'print_specs()' function. If you run this file, you should see two separate spec blocks outlining the Motorola Moto G5 and Samsung's Galaxy S8.

This might all seem complicated to begin with, but it allows us to standardise and simplify the coding through the uniformity given by using classes. What's more, we could also use the Computer class to create another subclass called 'Notebook', another called 'Desktop' and yet another called 'Server', all built from the base Computer class. Classes are incredibly powerful – inheritance makes them more powerful still.

## POLYMORPHISM

While inheritance allows a subclass to inherit the functions and features of a superclass, there are times where the superclass' functions need to be modified to suit the subclass, but you still want to use the same function name.

For example, if we added a function to the Computer class called 'print_cpu()', we might want it to describe the CPU as a 'processor' in that Computer class, but an 'SoC' (System on a Chip) for the

HP's Spectre x360 notebook is also a computer.

Samsung's Galaxy S8 might be a smartphone, but it's also a computer.

Smartphone class. But the problem you have then is two functions in a superclass-subclass setup with the same name. In a typical Python program, having two functions with the same name is a no-no, but like many other object-oriented programming languages, Python provides a solution for this and it's called 'polymorphism'.

To make the point, we've created a simplified version of the Computer superclass in the 'comp2.py' file that just includes the one parameter – CPU. It has a getter and setter, plus a print function called 'print_specs', which prints the name of the CPU followed by the word 'processor'. But it also includes the Smartphone subclass. Like the original Smartphone subclass, this new subclass incorporates the initialisation function that also calls the Computer class' initialisation function (__init__). What's different is that the Smartphone subclass also includes a print function called 'print_specs'. In other words, we now have a subclass that has a function with the same name as the one in the superclass.

How does Python know which one is which? On the basis of 'class hierarchy'. Look at the main() function – here, we create an instance of the Computer class called 'hpx360', followed by an instance of the Smartphone subclass called 'motog5'. Both classes call the print_specs() function. If you run the code, you'll see the hpx360 instance prints 'processor' at the end of the line, while the motog5 instance prints 'SoC' instead.

We say that the Smartphone subclass' print_specs() function 'overrides' the function of the same name in the Computer superclass. Note too that the Smartphone subclass' print_specs() function calls the get_cpu() function to get the name of the CPU, which it inherits from the Computer superclass. This is why inheritance is so important – as we said before, because Smartphone is a subclass of Computer, it also inherits the Computer superclass' variables and functions. Polymorphism takes this a step further, allowing the subclass to overwrite a superclass' functions to better suit the needs of the subclass.

As an exercise, try commenting out the Smartphone subclass' version of the print_specs() function and re-running the code. This time, instead of 'SoC' for the Qualcomm output, you'll get 'processor' instead – that's because the Smartphone class is now relying on the original Computer superclass version of the print_spec() function. Overriding a function is a great way of being able to use a consistent command to achieve an output, but still being able to create custom versions of that function to suit your subclass' needs.

smartphone.py - C:/Users/Darren/Python Code/Python_EP_18/smartphone.py (3.6.1)

File Edit Format Run Options Window Help

```
import computer

class Smartphone(computer.Computer):
    def __init__(self, brand, model, cpu, ramgb, os, price, \
                 screensize, batterycap):
        computer.Computer.__init__(self, brand, model, cpu, ramgb, os, price)
        self.__screensize = screensize
        self.__batterycap = batterycap

    def set_screensize(self, screensize):
        self.__screensize = screensize

    def set_batterycap(self, batterycap):
        self.__batterycap = batterycap

    def get_screensize(self):
        return self.__screensize

    def get_batterycap(self):
        return self.__batterycap
```

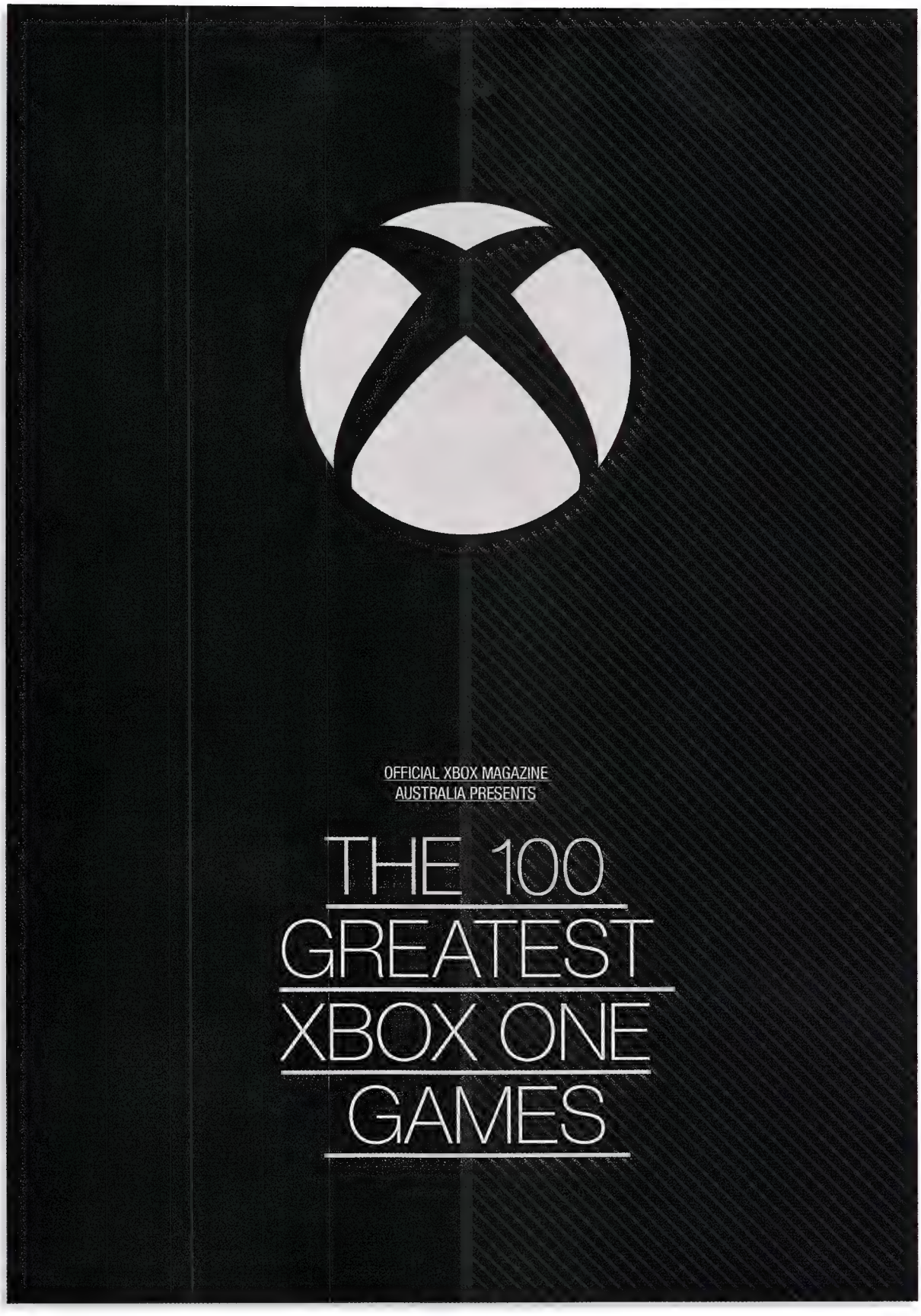
Ln: 17 Col: 32

Inheritance allows you to create more specific classes from a superclass.

## WHAT'S THE POINT?

Now reading this, you might be thinking this seems like a heck of a lot of work for a couple of fancy print statements. And yep, that's true – but you'd also be missing the point. By creating classes and utilising inheritance and polymorphism, you're creating a code structure that will be easier to maintain and yet will scale readily. We might be only dealing with a single CPU spec here, but imagine you're creating a customer sales transaction app, where each transaction has customer details, credit details, product details that all have to be recorded. Instead of manually creating variables and functions for each transaction, you just cookie-cut a new instance of a class that contains all those variables and functions automatically.

Object-oriented programming isn't the be-all solution for every computing problem, but it is one programming idea or paradigm that gets you thinking about the focus of your coding – and that's typically the objects you want to capture or represent in your code, whether it's something abstract like a transaction or sale, or an object more concrete like a computer or smartphone.

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Senu, the drone-like eagle that accompanies the player, is one of the game's neatest touches.

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# Assassin's Creed: Origins

## A sprawling open-world Egypt riddled with numbers.

**It's hard to detect at which point in recent gaming history numbers started to figure heavily into anything that wasn't a niche RPG. Nowadays, you see numbers everywhere, whether it's the interminable level grind of your average online FPS (*Overwatch*, *Battlefield*) or in once breezy and noncommittal arcade racers (*Forza*, *Need For Speed*). Games like *Diablo* arguably perfected the 'loot grind' – actually a cyclical, alarmingly futile chase for bigger numbers – but now, it's difficult to imagine any blockbuster game launching without some form of levelling attached.**

And so it is with *Assassin's Creed: Origins*, which has enjoyed a longer period of gestation since Ubisoft ceased dishing them out on a yearly basis. It's the archetypal, modern 'light RPG' – you won't need a spreadsheet to form an optimal build, but you'll sure as hell need to know how to count. Unlike earlier games in the series, your protagonist accumulates 'levels' and 'loots' items based on their rarity and various other numerical markers. And to be honest, these are among the only functional changes to the series since 2015's *Syndicate*. The meat and potatoes of the game – the moment-to-moment gameplay – stays much the same.

And yet, *Origins* is definitely among the best *Assassin's Creed* games I've played (and I've played nearly all of them). The ancient Egypt depicted here is gorgeous, sprawling through deserts and oases and ruins, taking us to the high seas and down into the dank treasure-strewn caverns of the actual bloody Pyramids. Protagonist Bayek is charismatic and, well, as vaguely interesting as an *Assassin's Creed* protagonist can be, and the tools he uses, such as his military-drone-esque bird, add a lot of flavour to both exploration and tactical stealth play.

Aside from the loot grind, *Origins* also sports the best combat system in the series yet, melding the DNA of Ubisoft stablemate *For Honor* with something like *Dark Souls* or *Bloodborne*. It's not as exacting and unforgiving as any of those, but the necessity to block and dodge and time your moves makes it a more exhilarating affair than the sticky auto-swipe rhythm of previous instalments.

For its world, and its combat, and the sheer joy of being in the game, *Origins* is a winner. But there are caveats: if you're the type to blaze through the main missions without a thought for side dishes, that's virtually impossible here: main missions are levelled, meaning if your character is at 8 and a mission is at 11, you'll pretty much fail it. Side missions are essential, then, and while they're occasionally great, the requirement to do them feels a bit pushy.

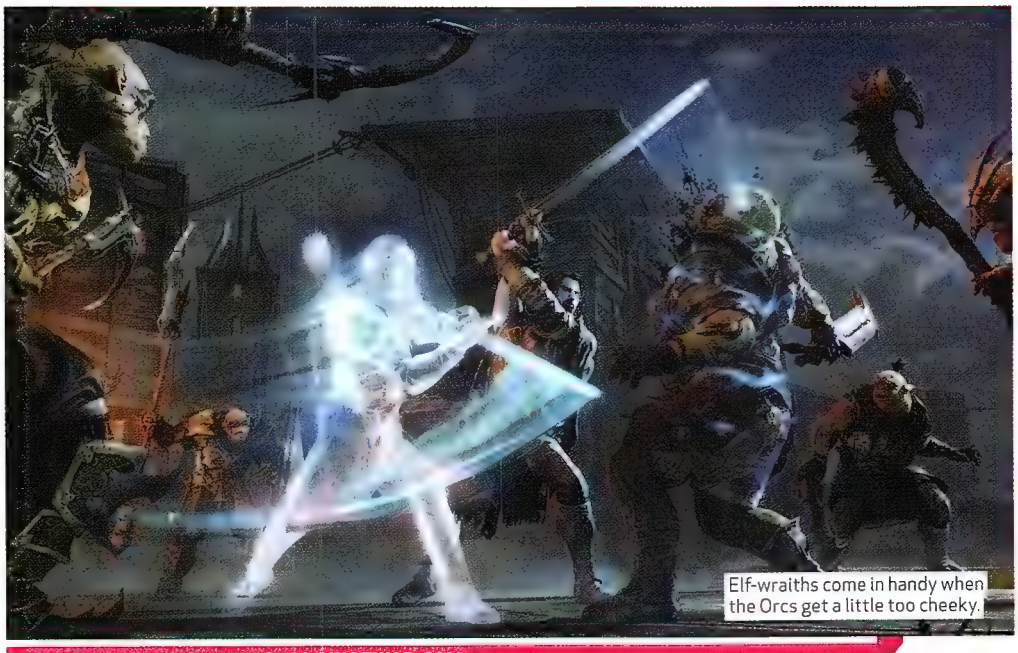
But if you're after a huge (to the tune of 60-odd hours) adventure, there's probably nothing better than *Origins* out this season.

■ Shaun Prescott

### Verdict

***Origins* finally delivers the game you always wanetd from the series. Brilliant.**

★★★★½



Elf-wraiths come in handy when the Orcs get a little too cheeky.

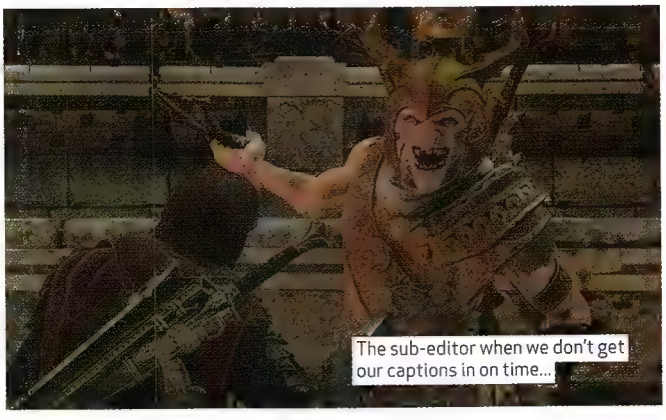
PC, PS4, XO | $99 | WWW.SHADOWOFWAR.COM

# Middle-Earth: Shadow of War

## Sevig thû úan.

**The first *Middle-Earth* game, *Shadow of Mordor*, released during the launch window of the current console generation, and probably benefited a lot from that. It boasted an interesting novelty in the form of the Nemesis system – basically an emergent approach to warmongering, which had enemies remember you and behave according to your past actions. But apart from this very clever system, it was a fairly drab open-world action game. Decent, but a little uninspiring.**

*Shadow of War* does address this last point – it's a much more varied and colourful game than what came before, but it's still beholden to the colour palette of the grimmest areas of Tolkien's world. The combat is as gripping and challenging as it was in the original, and fans of the Nemesis system will find a more substantial take in this instalment – if you're interested in the slaying of Orcs, the harming of Orcs, and the befriending of Orcs – this game is for you. Actually, 'substantial' seems to have been Studio Monolith's priority, because everything about *Shadow of War* is big, perhaps debilitatingly so. The game is awash with trivial and not-so-trivial things to do, which is great for those who buy games for their longevity value, and far less so for anyone who values their time.



The sub-editor when we don't get our captions in on time...

It seems weird to talk about 'valuing one's time' when talking about something designed for leisure, but boy is there a lot of noise in this game. Whether it's the nemesis meta – which also involves recruitment and entourage management – or the sheer number of objectives and side activities, there's a lot to do here for completists but by the same token, a lot to ignore for those inclined to mainline story missions.

When it comes to 2017's big open world games, *Shadow of War* isn't quite as engrossing and beautiful as *Assassin's Creed: Origins* or *Horizon: Zero Dawn*, but if you're invested in *The Lord of the Rings* world, love Orcs, and need to occupy around 100 hours of your life: give it a go. ■ **Shaun Prescott**

### Verdict

**Builds on the best bits of the original to become a ruthless, long conquest for orc corpses (and orc friends).**

★★★½☆

apc HOT PRODUCT

## Total War: Warhammer II

Add a splash of magic to your *Total War* experience.

**PC | $89.95**
**WWW.TOTALWAR.COM**

Having just lost the Tower of Lysean to a surprise attack in the North from the Cult of Excess, whilst reinforcements were blocking a feint by the High Elf faction of Caledor in the East, it's clear that, after only a few hours, we're already fighting a war on two fronts... But, contrary to the saying, in *Total War: Warhammer II*, fighting a war on two fronts is about as easy as it gets. The initial guided gameplay teaches you battle tactics, settlement management, initiating diplomacy, concealing assassination plots, managing unruly populations and raising settlements, all in a predictably *Total War* fashion. You'll need to be prepared to play as something other than the diplomatic High Elves — the game's new race list features Dark Elves, Skaven and lizardmen, keeping the battles chaotic and campaign styles unique. Improvements to the end turn notification system, construction tree and the addition of rogue armies, make this the most polished and enjoyable *Total War* game we've yet played. ■ **Joel Burgess**

★★★★½

## Pro Evolution Soccer 2018

More tortoise than hare – and all the better for it.

**PC, PS4, PS3, XO, 360 $99.95 | WWW.KONAMI.COM/WEPES/2018**

Through a combination of super-smart AI and superb animations, *PES* plays like the real deal. Thanks to some nifty contextual shielding, players are smarter when it comes to protecting or fighting for the ball. Everything you've come to expect of *PES* on the pitch is as strong as last year. Passing with purpose remains as satisfying as ever. The game also continues to excel when it comes to tactics. OK, it takes a little too much menu-diving, but the fact you're able to set up a team to play the way you want, while trying to exploit opposition weaknesses gives the action a depth that'll keep you coming back all year. There are a few blemishes to the on-field action, though. Defenders tend to be far too slow in turning and the AI understands the new shielding system maybe too well as they're hard to nick the ball off and rarely give away fouls. Coming away from the pitch is when things take a turn for the inconsistent. There's a lot to the myClub mode but it never manages to be accessible or addictive. At least Master League receives a little TLC this year, but there's still a lot of unnecessary menu-diving. It's not quite a knockout blow against *FIFA*, but *PES* continues to be a fantastic representation of the beautiful game.

■ Ben Tyrer

★★★★½

**SWITCH | $79.95 | WWW.NINTENDO.COM.AU**

# Super Mario Odyssey

## Hats off to Nintendo for its latest masterpiece.

**With the release of the critically lauded *Zelda: Breath of the Wild*, Nintendo took one of its most beloved franchises back to the drawing board and eventually delivered one of the finest and most accomplished titles in its entire history. Now, it's Mario's turn to get a shake-up, and while it's not quite as extreme as the one Link received earlier in the year, it's easily the most inventive and refreshing adventure the portly ex-plumber has embarked on yet.**

In *Super Mario Odyssey*, our hero is once again tasked with saving Peach from the maniacal Bowser – yes, this sounds very familiar, but wait for it – this time, he's trying to prevent the evil tyrant from making the princess his wife.

This leads Mario on a chase across many kingdoms as Bowser visits each one and steals their most prized possessions for the upcoming wedding. If Mario has any hope of catching up, he'll need to keep his airship, the Odyssey, topped up with Power Moons, which are scattered across each kingdom. Where the game changes things is up is in its approach to how Mario acquires these powerful collectibles.

No longer are you faced with a set number of levels to clear – now you can roam freely throughout its themed worlds as you search for the Moons in a scavenger hunt-like fashion.

You won't find any of Mario's famous power-ups in this game, either. But this isn't as insane as it might sound. Instead, you'll take control of Cappy, a sentient hat that Mario can use to possess a wide variety of enemies and objects, including T-Rexes, tanks and everything in between.

It's a great gag, and yet Nintendo approaches the business of playing as a frog – and, indeed, as any of the 50-odd other possible skins – with total seriousness. It pays close attention to the physics and handling of each of these new forms, making each one enjoyable to command. And there are usually clear benefits to specific transformations. They're not always essential, and in many cases, Mario's repertoire is enough to get by (his triple jump is back!), but it's often easier or quicker to make the switch.

Another change is with lives – they've become a thing of the past. Now, failure means losing a small amount from your overall coin total (which you can also use to buy totally sweet new costumes). At first, we were taken aback by these radical changes, but soon enough, we became hooked by the sense of discovery and surprise that this approach brought on.

Endlessly endearing and charming to a fault, *Super Mario Odyssey* is the most addictive and enjoyable Nintendo Switch game to date, and a great addition to the *Mario* series, which, we'll admit, badly needed a bit of stirring up.

■ Stephen Lambrechts

### Verdict

**Mario has never felt better in the palm of your hand than in *Odyssey*. It's taken risks, and all have paid off nicely.**

★★★★★

apc HOT PRODUCT

PC, PS4, XO | $99.95 | WWW.THEEVILWITHIN2.BETHESDA.NET

# The Evil Within 2

## Modern survival horror that evolves the genre in subtle ways.

**Directed by legendary horror icon Shinji Mikami (*Resident Evil*), the original *Evil Within* suffered all of the problems you'd associate with a survival horror game indebted to the past. Sure, it was petrifying and psychologically draining, but it was also a pain in the arse – difficult, clunky and frustrating, in all the ways old *Resident Evil*s can feel to modern players. *The Evil Within 2* shares the same protagonist with that first game but sheds a lot of what made that first instalment mediocre, resulting in what could be the best survival horror game since *Alien: Isolation*.**

You play as ex-detective Sebastian Castellanos, newly kidnapped by dodgy organisation Mobius to enter its strange alternate reality in pursuit of his daughter (and Mobius's nefarious objectives). This is a neat setup, because it allows *TEW2* to abandon the logic of reality entirely. So you'll be wandering small townships that have crumbled to pieces, avenues and blocks floating in the sky, and you'll be exploring the common household variety of scary mansion, too. This sequel switches between linear, traditional survival horror proceedings and a handful of mini sandboxes, while managing to retain the tension needed to keep it ticking. It's a lengthy game, though it doesn't get taxing because it's not as punishing as other modern horror games. Sebastian has a variety of skill-trees that advance his abilities in meaningful ways, and while the combat is hardly as snappy as, say, *Gears of War*, you'll rarely feel like the odds are entirely against you. Ammo can be scarce, but it's usually because you've not scoured the areas for resources, and not because it wants you to feel disempowered.

*TEW2* manages to walk the tightrope between horror and action, successfully mixing adventure with despair in a way that's actually fun.

■ Shaun Prescott

### Verdict

***The Evil Within 2* has taken all the good bits from its predecessor and added the necessary ingredient: fun.**

★★★★★

apc RECOMMENDS

## Absolver

Make your move.

**PC, PS4 | $29.95 WWW.ABSOLVERGAME.COM**

At first, helping hands seem few and far between. A brief tutorial brushes over the basics of fighting. There's a chance to practise your special class, a scuffle with a gatekeeper, and then you're free to roam the ruined kingdom of Adal. Fighting is defined by your combat 'deck', a set of four customisable chains of moves that you can switch between for unpredictable flurries of blows. Pressing buttons in practised rhythms and dodging, one eye on your stamina bar, will get you halfway, but the key to advanced play lies in the Meditation menu. Entering it allows you to spend earned attribute points, edit your deck and test out the changes in Practice mode. The problem is that the system is never quite explained. Introductory fights are unintuitive: experimental presses of the same button yielding different results each time. Successfully defending against certain blows raises a meter: win the fight, and you keep XP for that move. Fill the meter entirely, and you'll add it to your repertoire. When things are working, however, the battle system shines. Every one-on-one exists on a knife edge between skill and luck, planning and instinct, clumsiness and elegance. The purity and quality of *Absolver*'s vision has provided an innovative, constructive take on an often impenetrable genre.

★★★★½

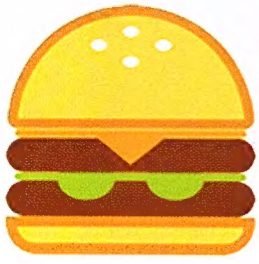
# China may ban *PlayerUnknown's Battlegrounds*

## For deviating from 'socialist' values...

*PUBG* is a hugely popular online battle royale game on PC, expected to be released from Early Access by the time you read this (with an Xbox version also to come). The premise of the title is simple – up to 100 players parachute onto an island and must hunt for weapons, armour and other equipment, before then going about systematically killing everybody else on the map and hopefully not dying. However, this type of last-man-standing deathmatch-style of game has not gone down well with the China Audio-Video and Digital Publishing Association, who stated that the game was too violent for a Chinese audience and that its core values contradict the government's goal for social unity. The less realistic *League of Legends* multiplayer online battle arena, however, is totally fine... China currently has the largest percentage of *PUBG* players worldwide (making up a whopping ~47% of the total), all of whom only have access to the game via VPNs.

Apple

Google



HTC

## Battle of the burgers

WHAT CAME FIRST? THE MEAT OR THE CHEESE?

Writer Thomas Baekdal posted on Twitter that there was a discrepancy between Apple and Google's interpretations of what a hamburger looked like. They had all the right ingredients [*Excluding pickles, beetroot, bacon and egg – TC*], but there was some confusion as to the order of those ingredients. Apple goes for the (bottom to top) bun-lettuce-meat-cheese-tomato-bun method, while Google employs the bun-cheese-meat-tomato-lettuce-bun. In response to Baekdal's post, CEO of Google Sundar Pichai jokingly promised that Google "will drop everything else we are doing" to solve the problem. Of course, it's not just Google and Apple that disagree. According to this website (**emojipedia.org/hamburger**), LG and HTC forgo the tomato, Mozilla drops tomato and lettuce, and emojidex ditches the cheese! The most disturbing of all, however, is how the HTC hamburger emoji looks uncannily like a fat bird wearing a tight green bra...

## Saudi Arabian robot gains citizenship

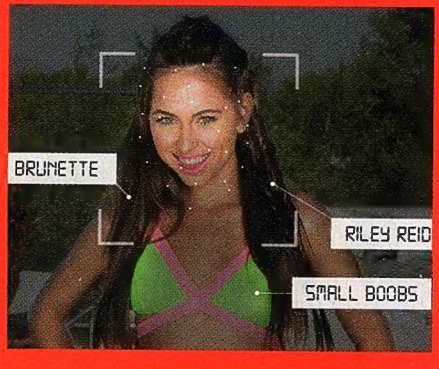
WORLD FIRST FOR ROBO-RIGHTS?

Sophia wants to live and work with humans, and her incredibly expressive face is one of the ways Hanson Robotics says she and her kind will be able to better achieve this goal. At the Future Investment Initiative in Riyadh, Saudi Arabia, Sophia was interviewed about her purpose ("I will do much best to make the world a better place"), and she also showed off her range of facial expressions. During the conference, she was awarded citizenship, which is more than a little awkward (especially in a country criticised for its lack of female equality).

## Pornhub's search ability is getting a hand...

FROM AN AI.

You know what's really hard? [*Uh... – Ed*] Oh, sorry. It's really *difficult* to find specific videos on Pornhub, apparently, due to the fact that its contributors aren't overly creative with their tag words. That makes finding new and exciting content catering to your particular fancy an unnecessarily hard [*'Difficult'? – Ed*] process. Well, Pornhub is looking at potentially implementing a type of AI that will scrutinise every frame of every video, looking for features to tag, and metadata to add to its vast database, including actor names, hair colour, positions, activities and locations. We're not sure what happens if an actor's face is obscured by a mask, though, and due to an events clash, our resident 'special interests' journalist Shaun Prescott is unfortunately unavailable to interview anyone from Pornhub to ask. Soz. ■



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